Chesapeake Bay—Sea Level Rise, Salt Water and Sinking Septic Systems: Land Use And Public Health Policy Challenges

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VDH VIRGINIA DEPARTMENT OF HEALTH
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[gis.lancova.com]

2019

2019

A very quick primer on septic systems

Public Health, Ground Water, Surface Waters

Epa.gov

Rising Groundwater

Flooding and Overwash

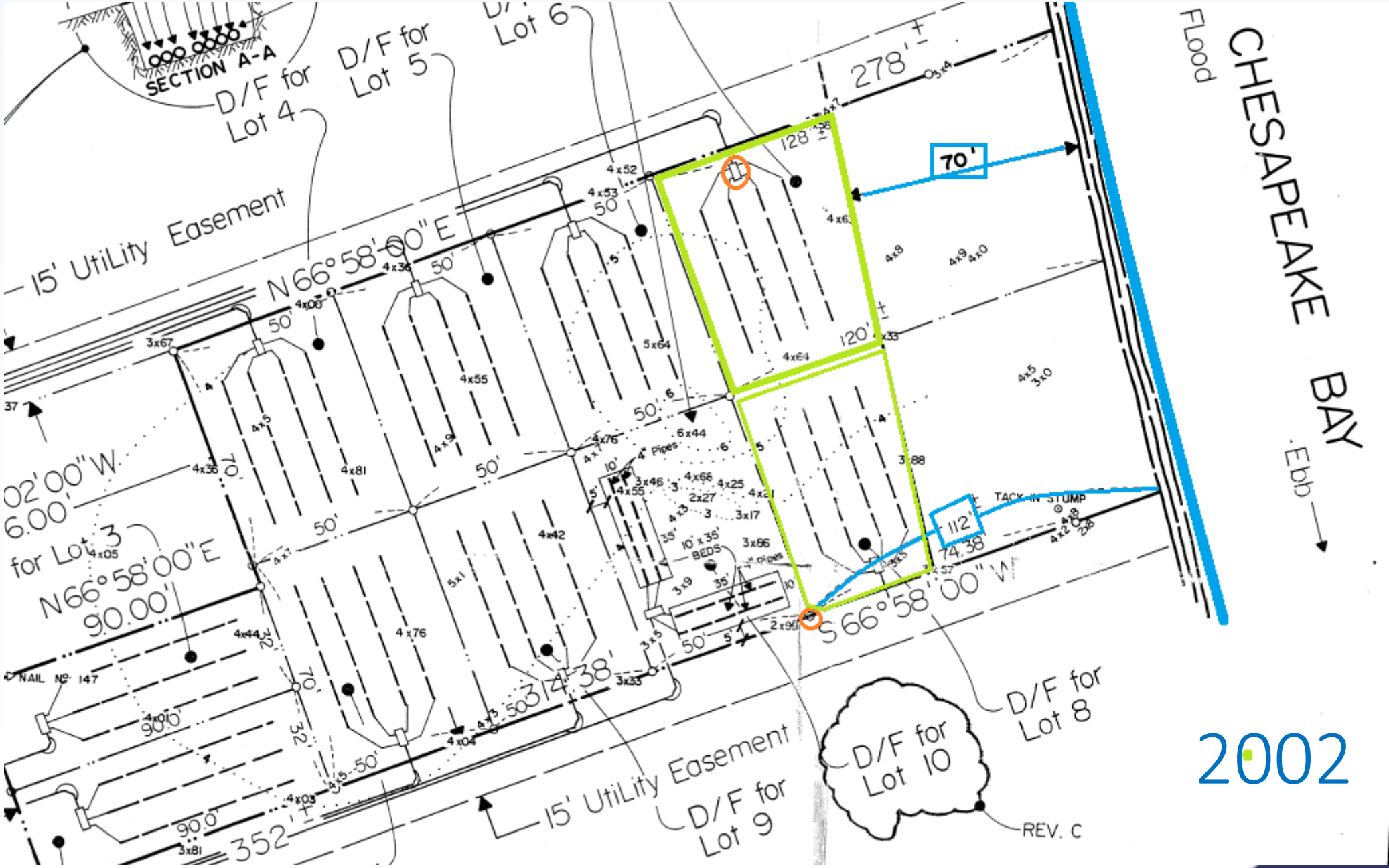
Rising Groundwater

Flooding and Overwash

Erosion

Erosion

Rising Groundwater


SECTION A-A
D/F for Lot 4
D/F for Lot 5
Lot 6
278' ±
15' UtiLity Easement
N66°58'00"E
50'
128' ±
70'
120' ±
CHESAPEAKE BAY
Flood
Ebb
TACK-IN STUMP
112'
74.38'
S66°58'00"W
02'00"W
6.00'
for Lot 3
N66°58'00"E
90.00'
NAIL No. 147
90.0'
352' ±
S03°14'38"E
15' UtiLity Easement
D/F for Lot 9
D/F for Lot 10
D/F for Lot 8
REV. C

2002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TACK IN STUMP
10' x 35' BEDS
4" Pipes
for Lot 3
N66°58'00"E
90.00'
02'00"W
6.00'
NAIL No. 147
S03°14'38"E
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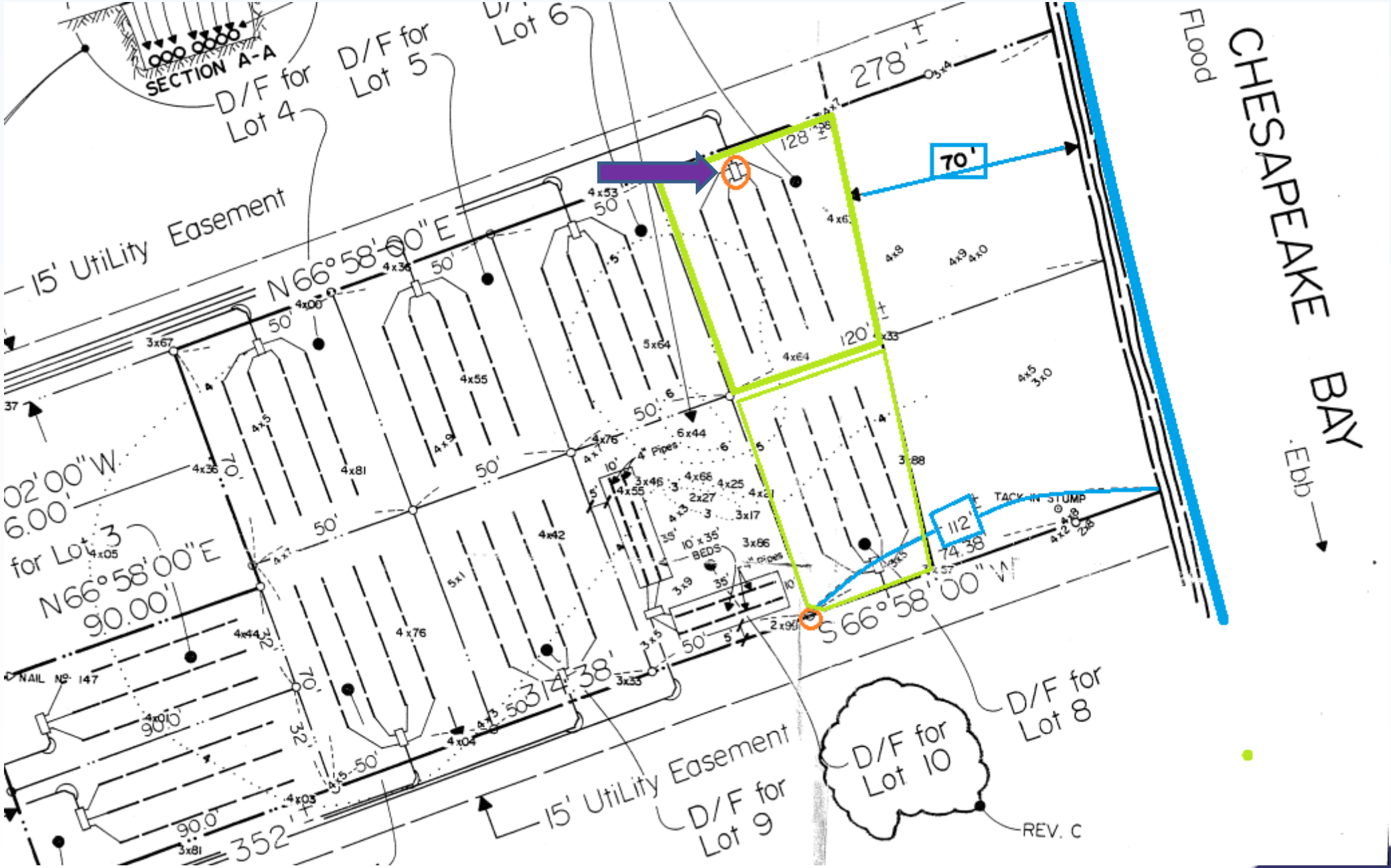
D/F for Lot 9
D/F for Lot 10
D/F for Lot 8
REV. C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REV. C

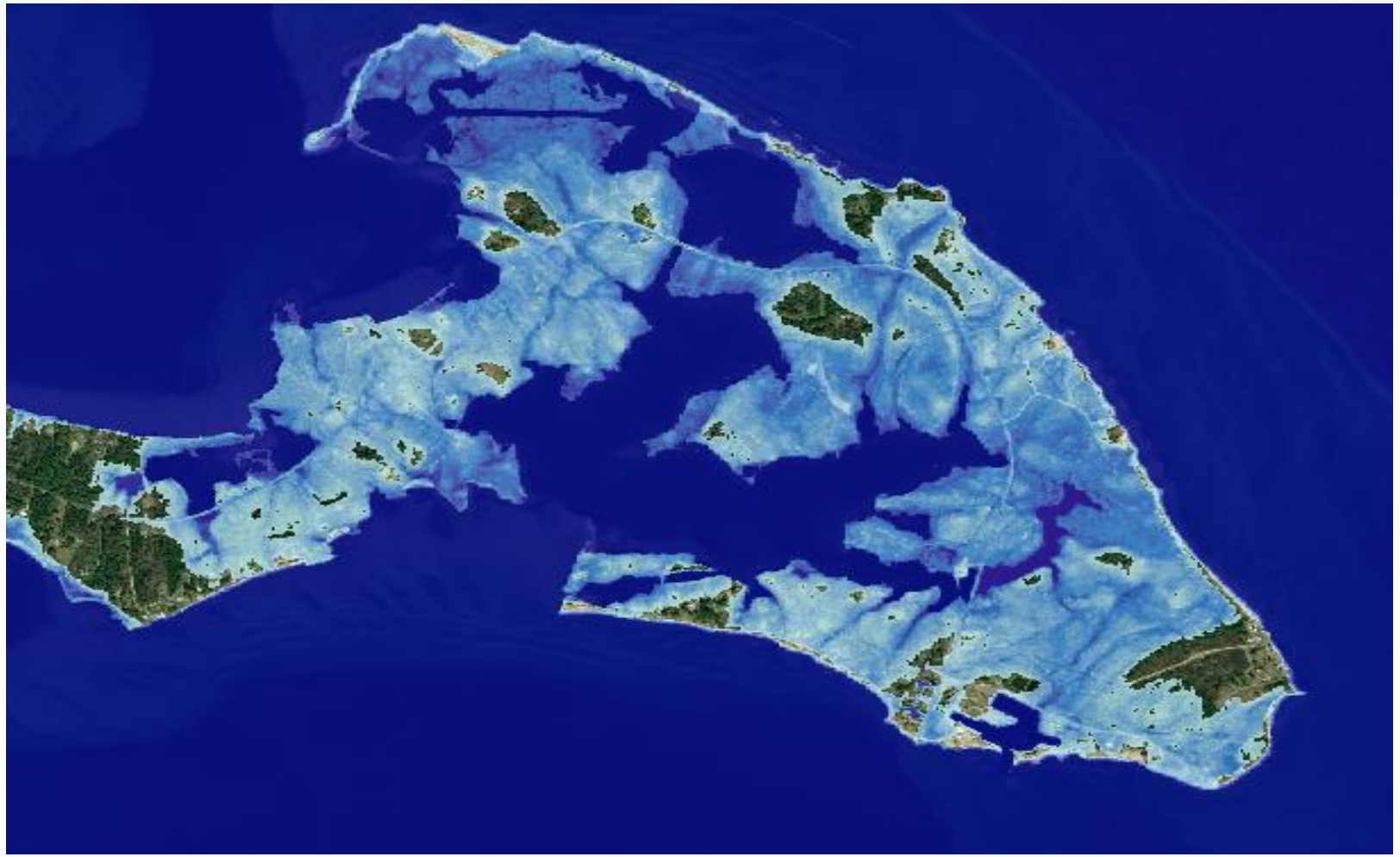
2019

2019

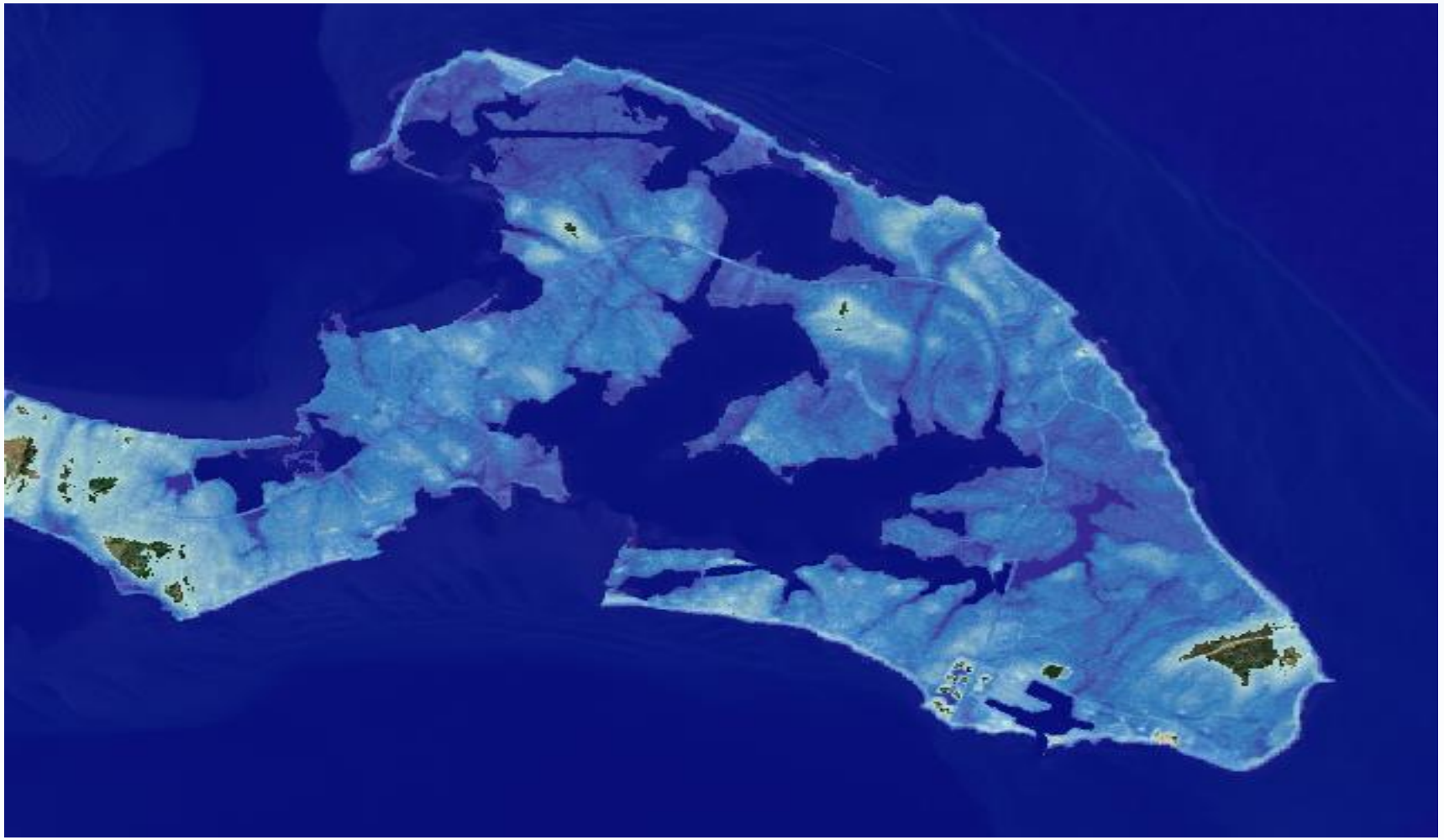
2050

2065

2080

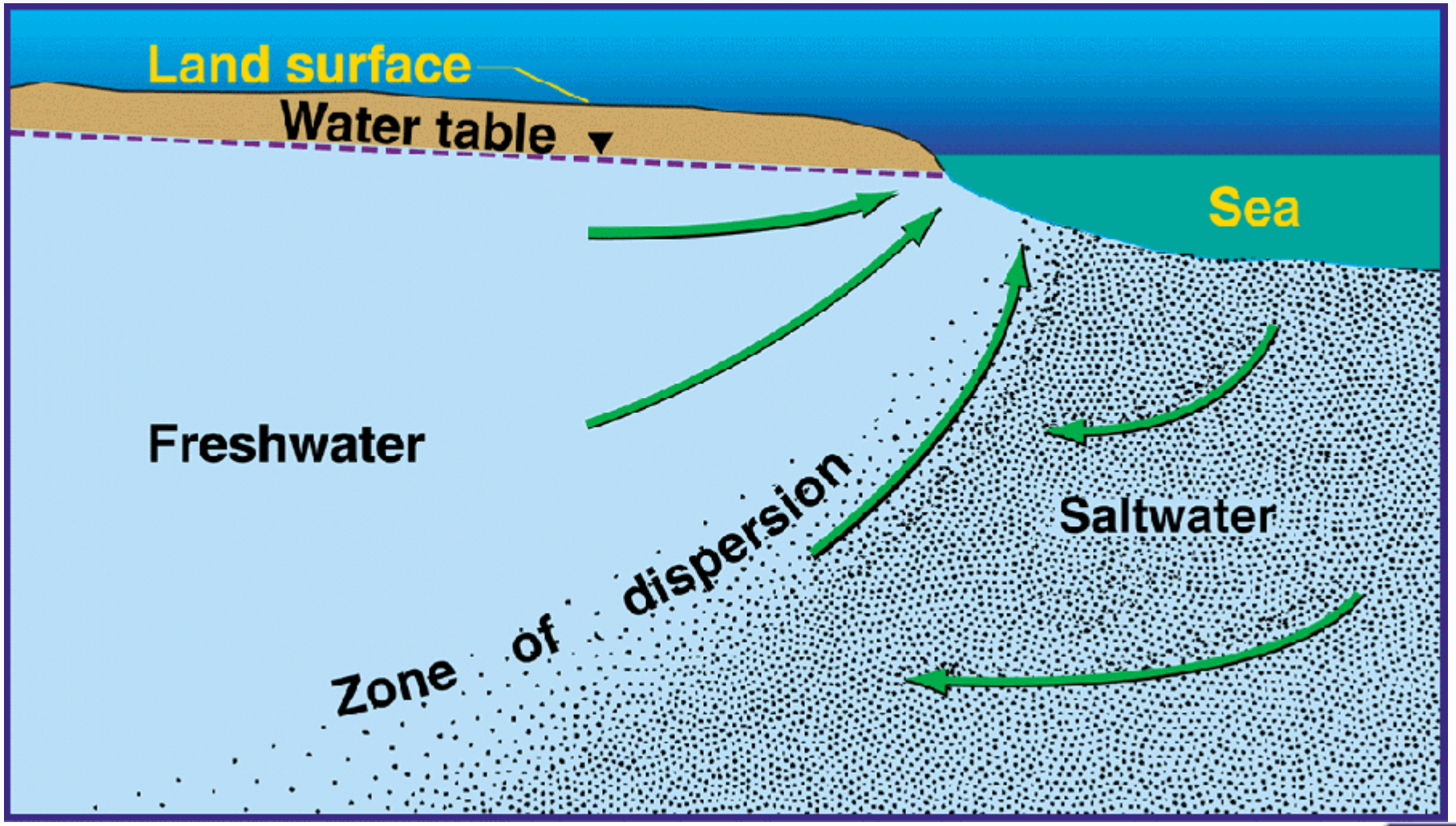


2090



2019

Rural Owners Drink Water From Their Property



U.S. Geological Survey Water-Supply Paper 1613-C

Coastal Private Wells May Feel Impact from Sea Level Rise

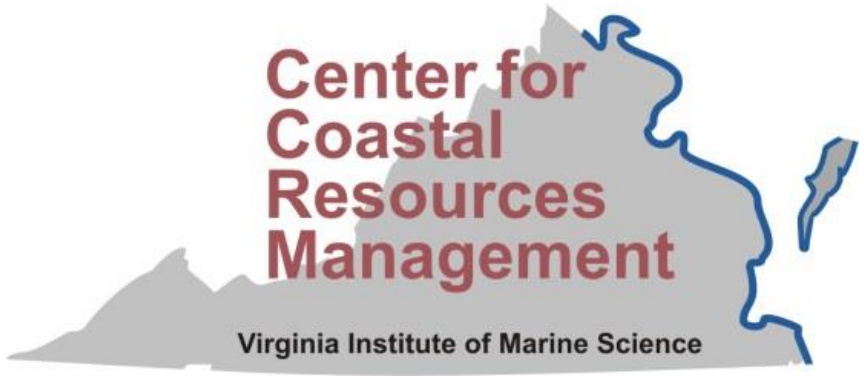
[National Environmental Education and Training Foundation]

Policy Challenges

- VDH needs to maintain its role as a trusted source of reliable information that localities and the public can rely on when making decisions that will live into the future.
- When assisting local government with public health impacts of land development, VDH regulation has not historically needed to address climate change when making its decisions.
- Public policy changes will receive public support when they are founded on specific, tangible projections that stakeholders have confidence in. Keeping the best, most accurate and local knowledge in the public eye is key.

Finding Current and Potential Future Septic System Failures

Carl Hershner
Julie Herman
Robert Isdell
Christine Tombleson
Molly Mitchell

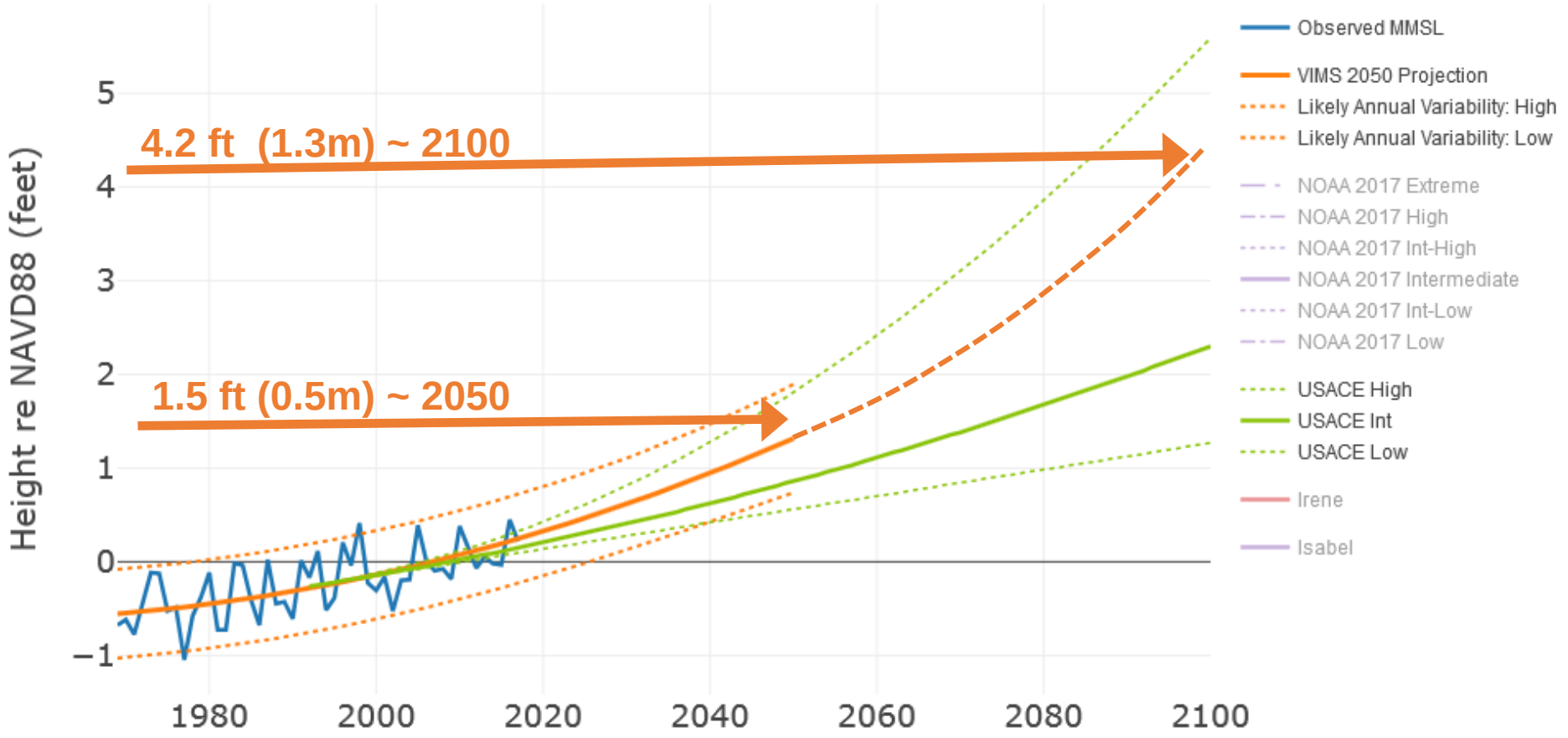


VIMS | William & Mary
Virginia Institute of Marine Science

Center for Coastal Resources Management
Virginia Institute of Marine Science

Sea Level in Virginia
Historic data and projections

ADAPT VA



How rising sea level affects water table level

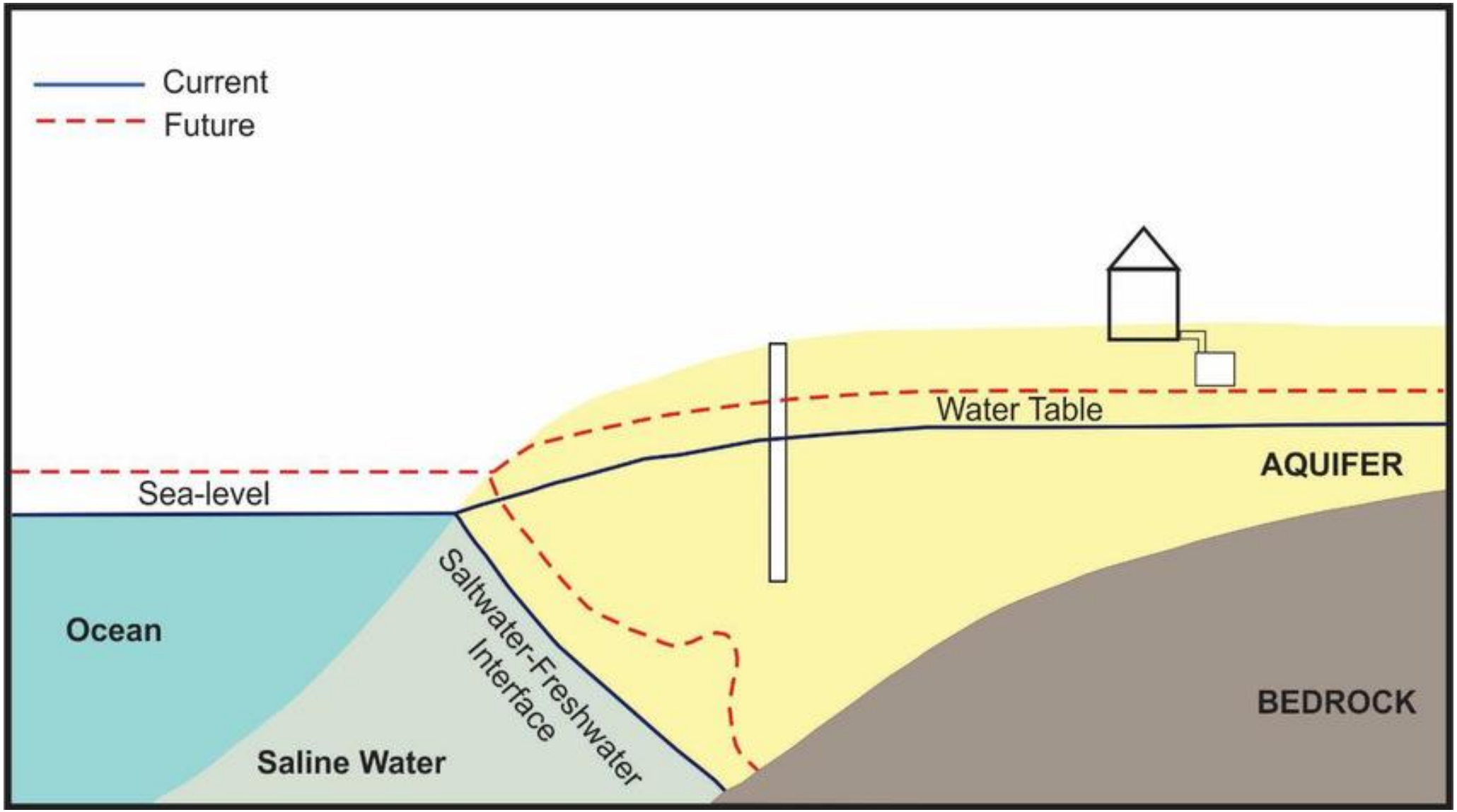
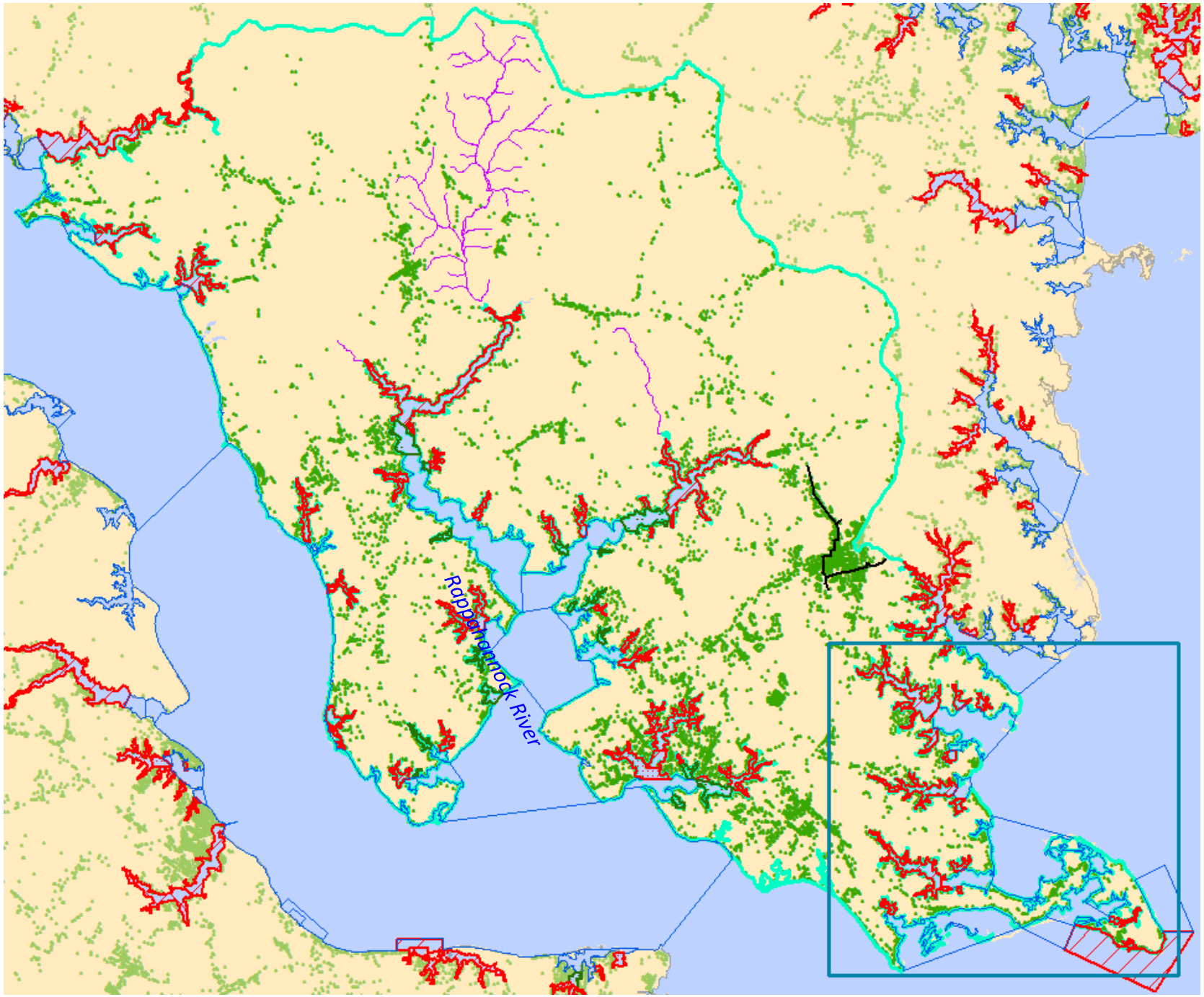


Figure from Jamaluddin, et al. 2016. Threats faced by groundwater: A preliminary study in Kuala Selangor. Researchgate. 9p.



Lancaster County

Virginia Address Points

sewerlines_distrib--VEDP

lancaster_co

ClassifiedShellfishWaters20180228

COND_TYPE, CLOSED_PARAMETER

Emergency Restricted, Year Round - Relay Only

Prohibited

Restricted

Seasonally Restricted (Closed Apr-Oct)

Conditionally Approved (Closed 10days following >0.5" rain)

Conditionally Approved (Closed 10days following >1" rain)

Conditionally Approved (Closed Apr-Aug)

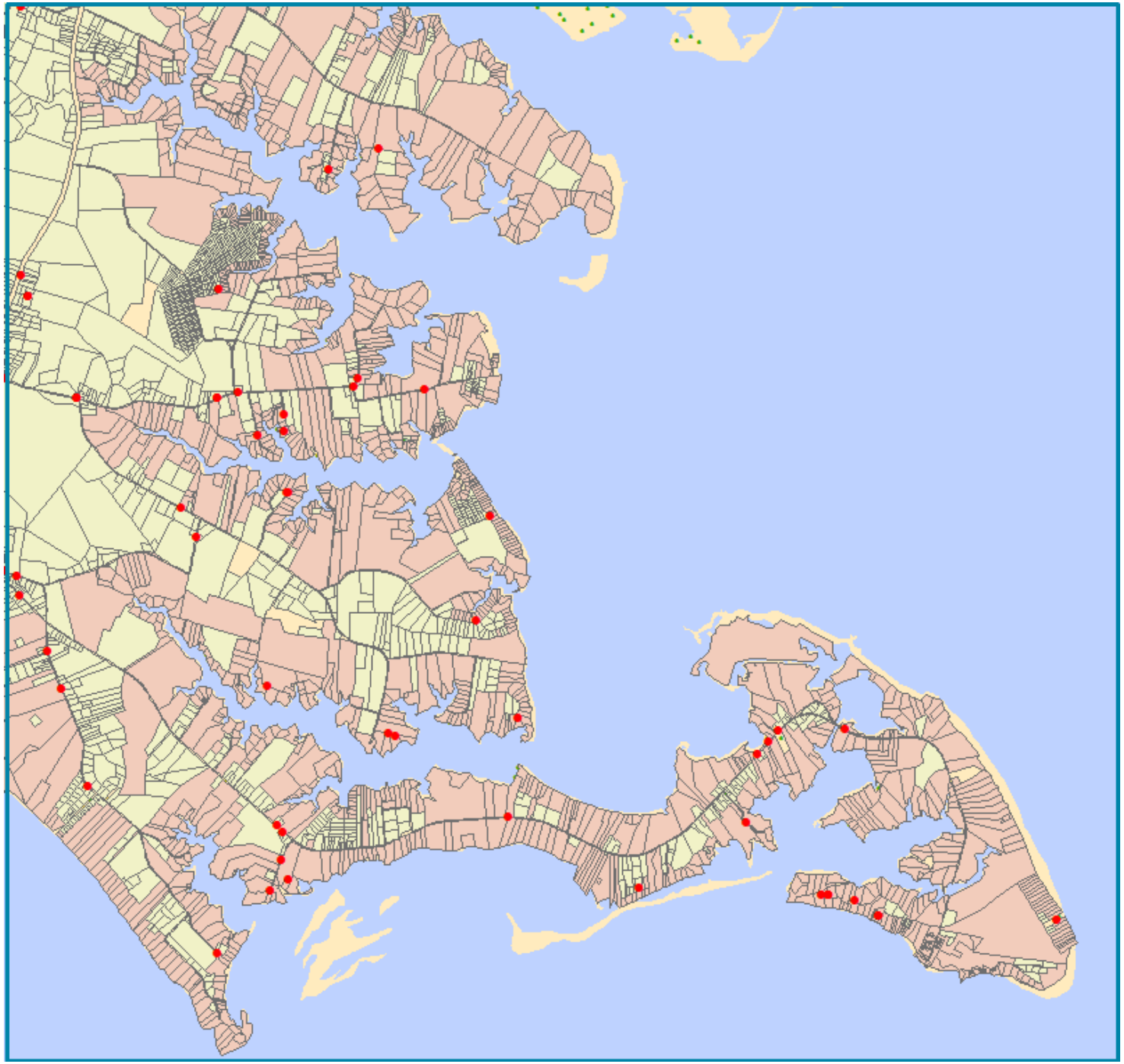
Conditionally Approved (Closed Apr-Oct)

Prohibited-Nonproductive, No Resource

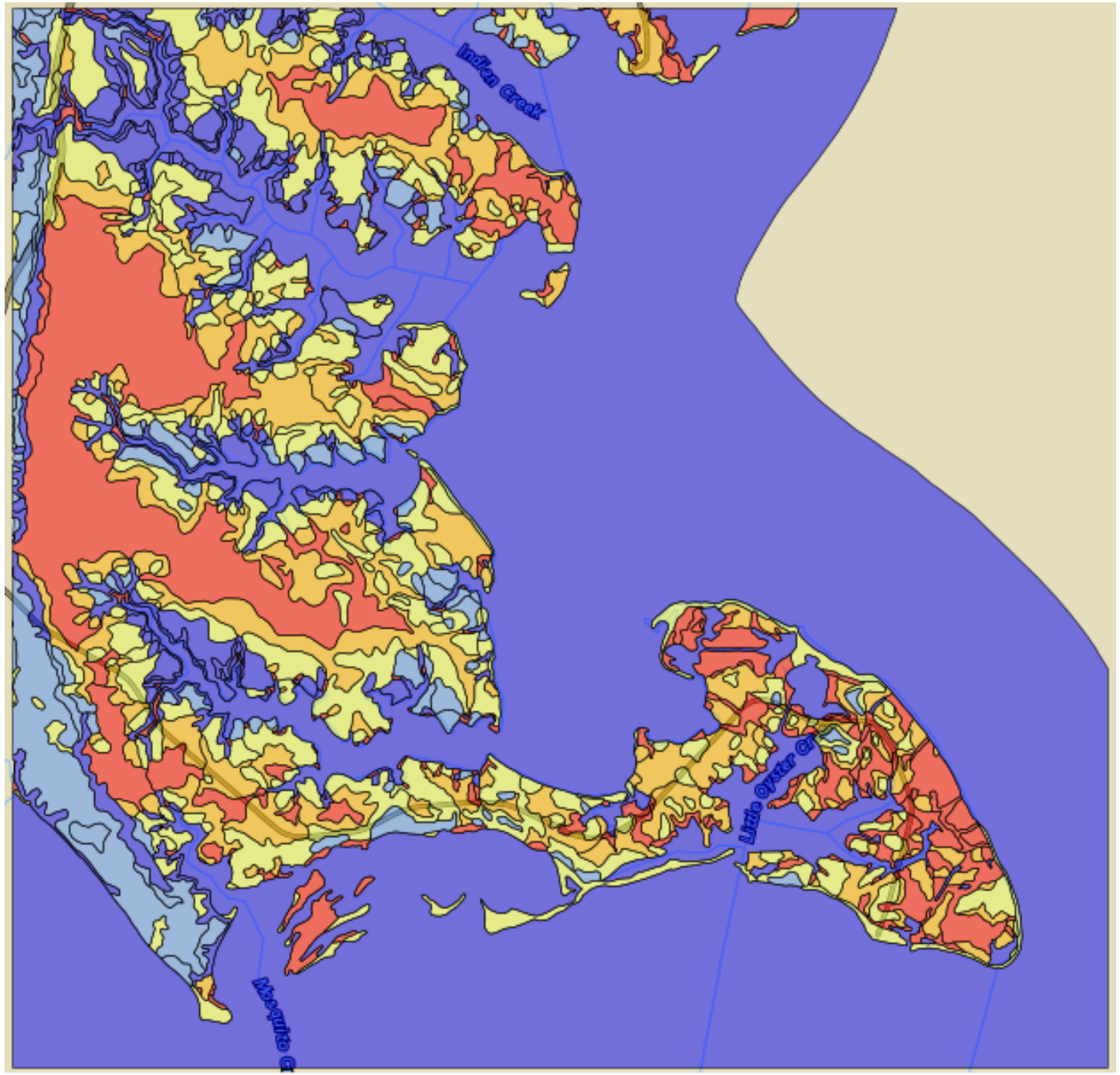
Open, NA

Ecoli

yes



State database on repair permits (red dots), waterfront parcels (orange), other parcels (tan)



Lancaster County site

Depth to water table

centimeters	inches
0 - 25	= 0 – 10”
25 - 50	= 10 – 20”
50 - 100	= 20 – 39”
100 - 150	= 39 – 59”
150 - 200	= 59 – 79”
> 200	> 79”
Not rated or not available	

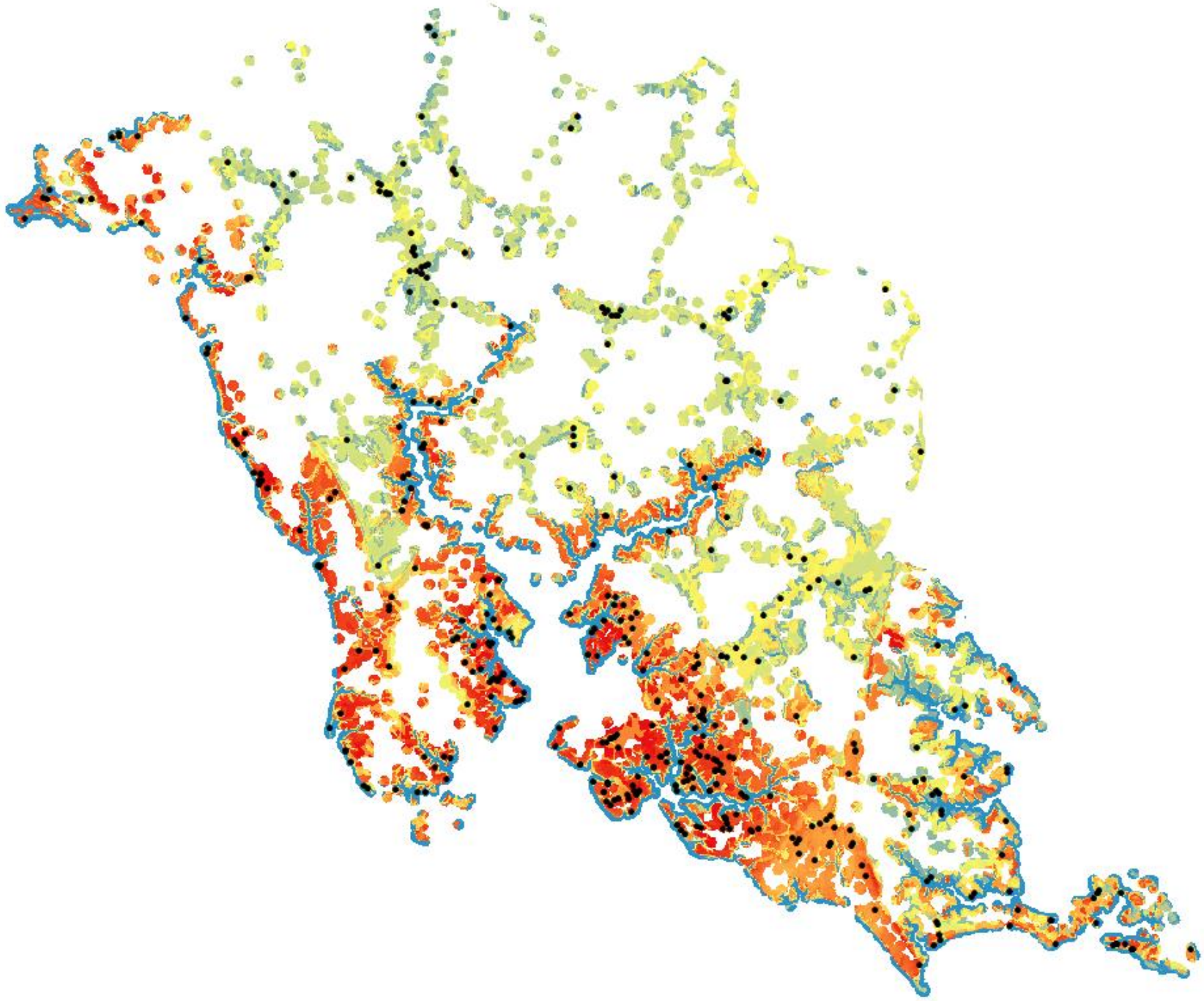
Lancaster County

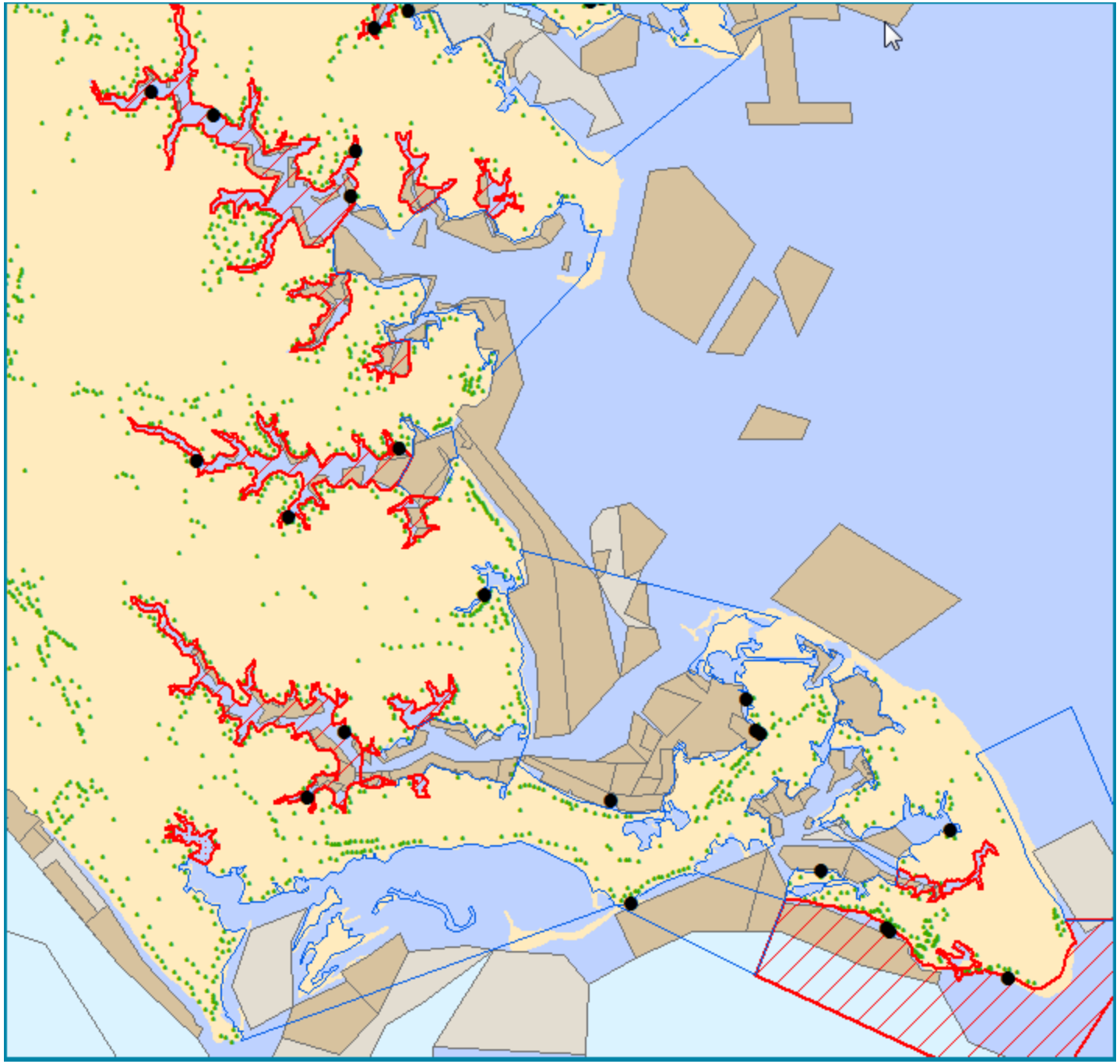
1 county in analysis

Environmental variables:
Elevation
Depth to water table
Hydric rating
Percent sand
Septic absorption

- Septic failure

Probability of failure





- Oyster garden permits (private)
- ClassifiedShellfishWaters20180228
  - COND_TYPE, CLOSED_PARAMETER
  - Emergency Restricted, Year Round - Relay Only
  - Prohibited
  - Restricted
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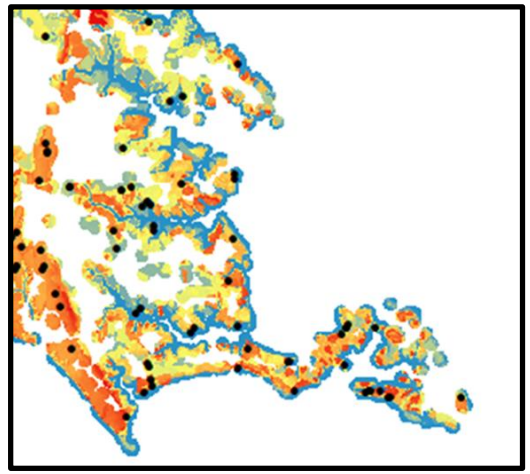
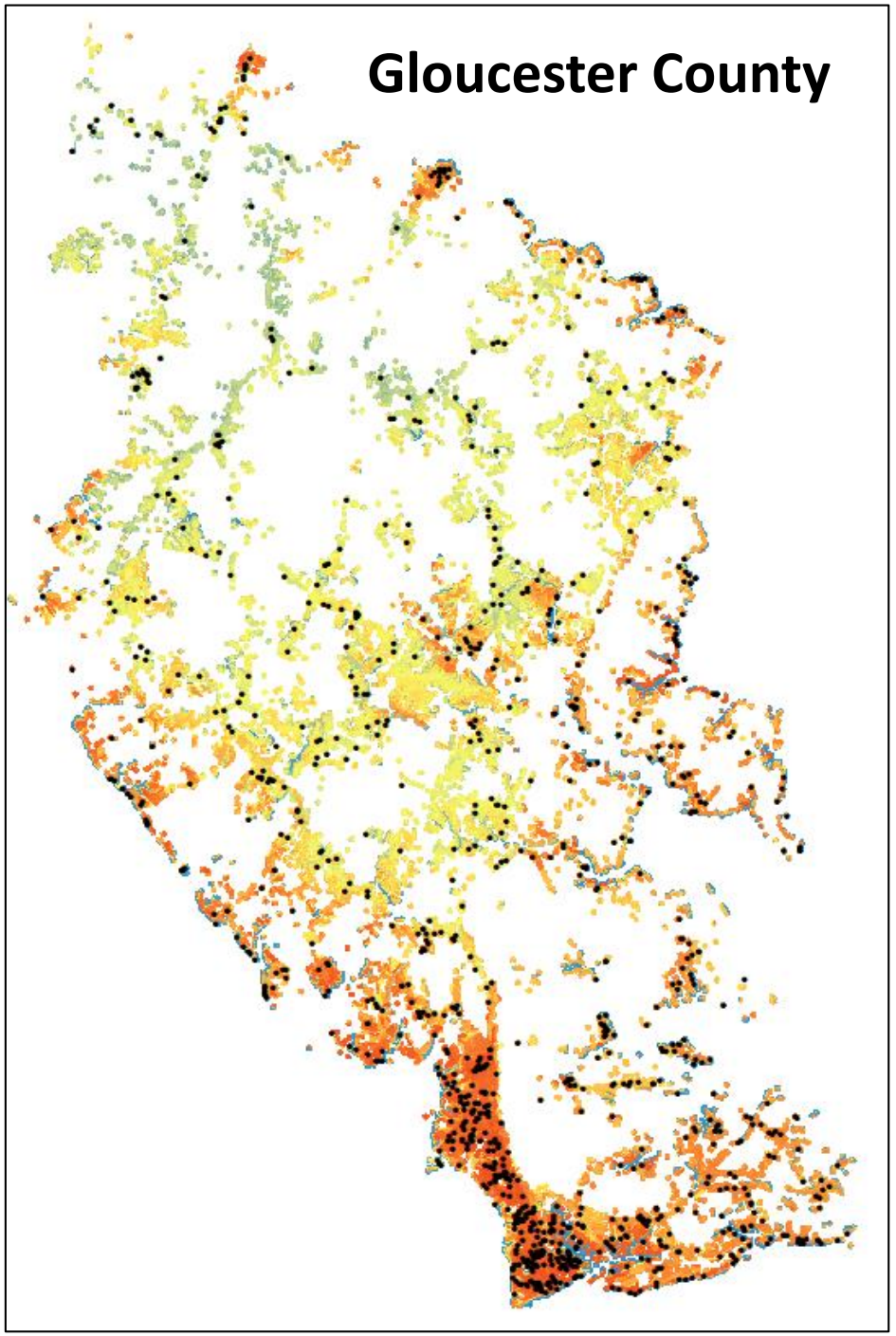
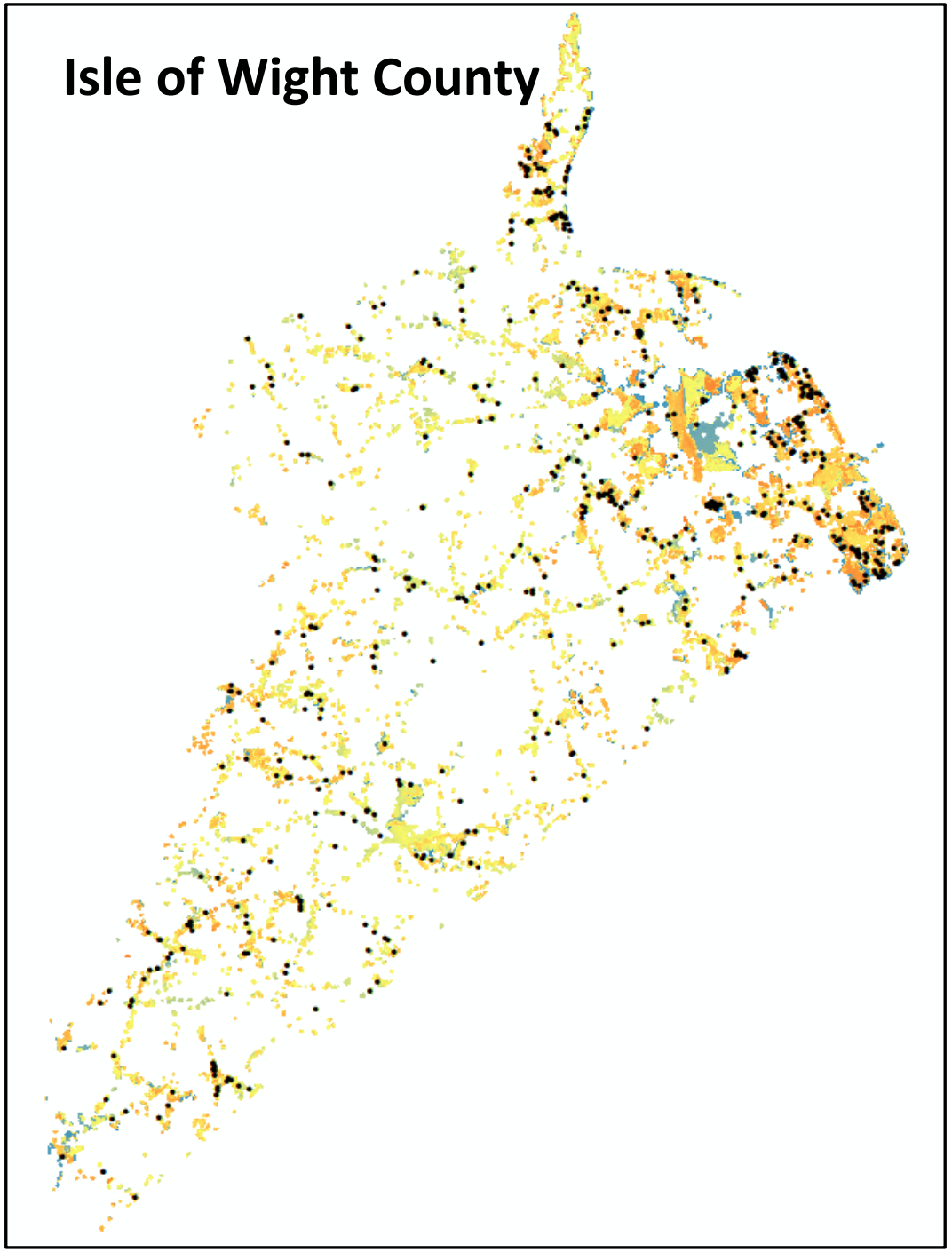
  - Conditionally Approved (Closed 10days following >1" rain)
  - Conditionally Approved (Closed Apr-Aug)
  - Conditionally Approved (Closed Apr-Oct)
  - Prohibited-Nonproductive, No Resource
  - Open, NA
- Virginia Address Points
- Oyster ground applications (private)
- Oyster ground leases (private)
- Baylor grounds (public)



- Septic failure

Probability of failure





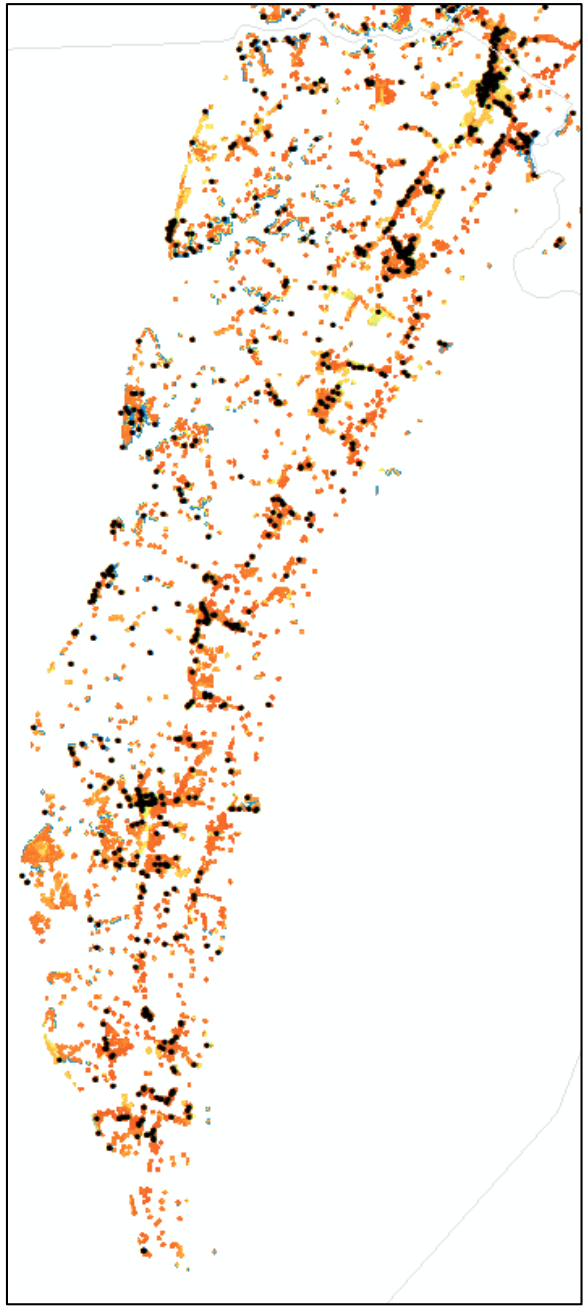
Northampton County

- Septic failure

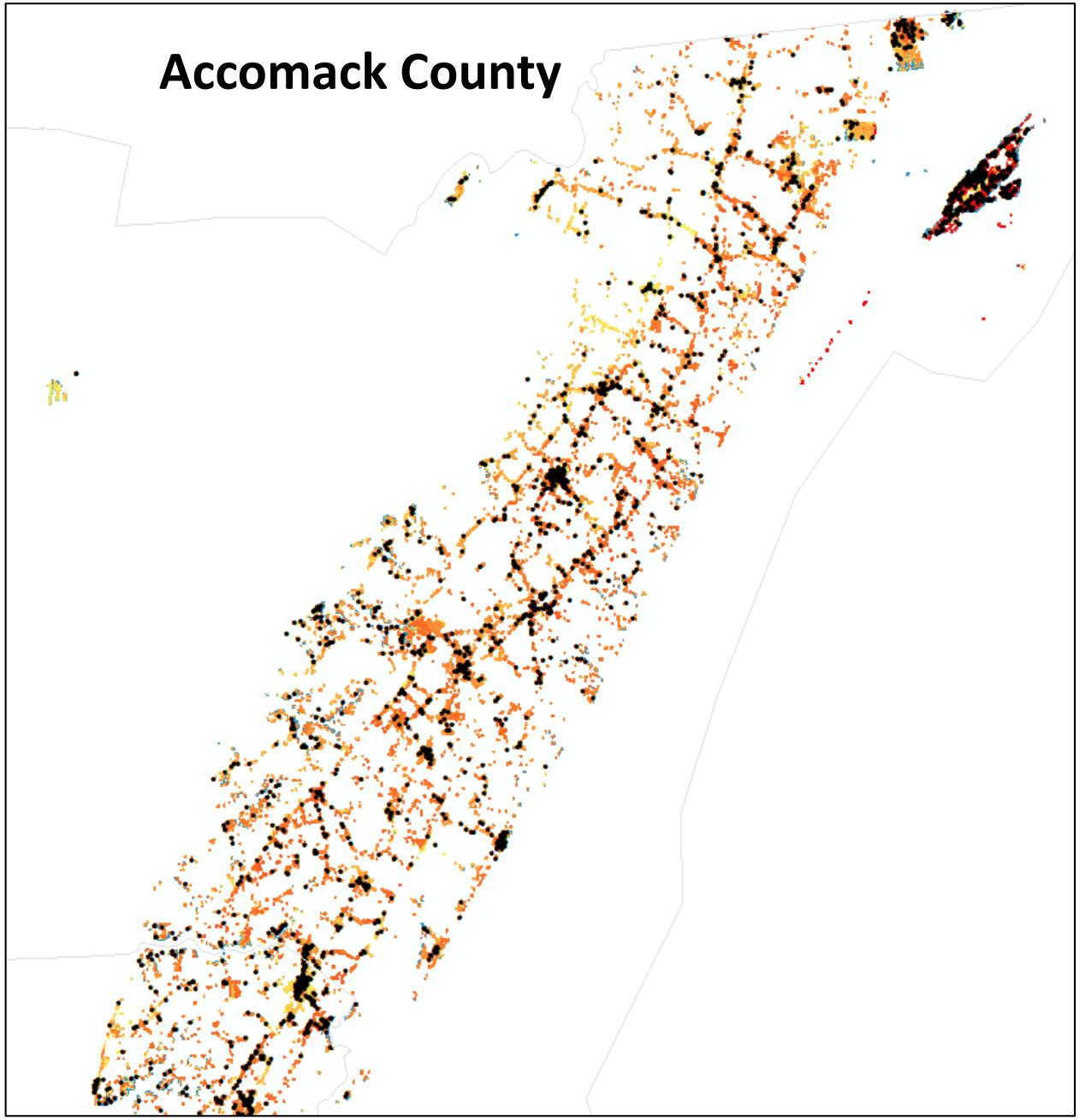
Probability of failure

High :

Low :



Accomack County



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Vibriosis in Virginia

Keith Skiles, MPH
Katie Kurkjian, DVM, MPH
Public Health Impacts of Climate Change Summit
June 10, 2019

Disclaimer

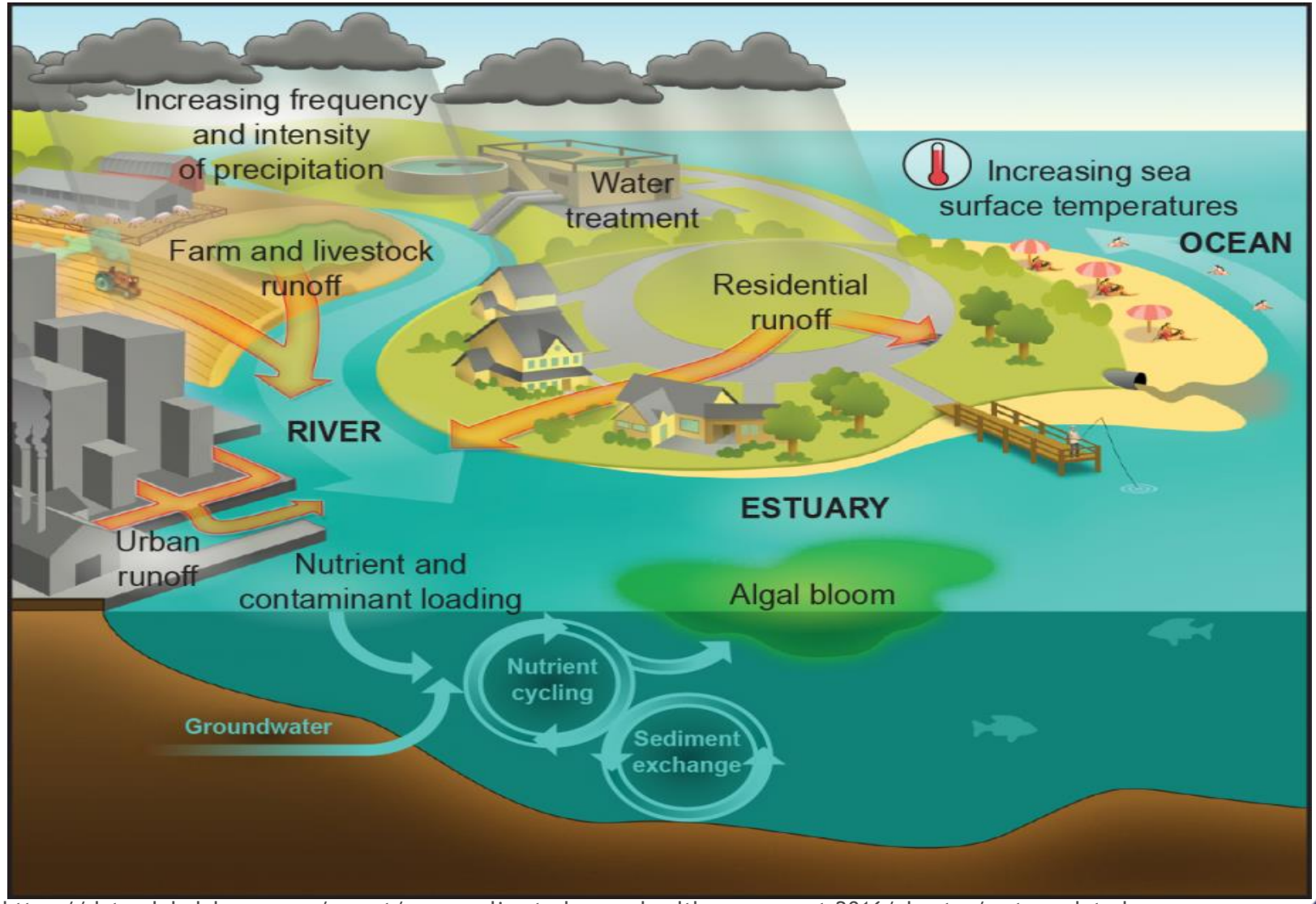
The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Vibriosis

- Infection with pathogenic species of *Vibrionaceae*
  - Excluding *V. cholerae* O1 and O139
  - Mainly causes gastroenteritis, sepsis, or wound infection
- Acquired by eating raw or undercooked seafood or contact with saltwater or brackish water
- People with liver diseases, cirrhosis, immunosuppression, malignancies, and alcoholism at greater risk of serious infection

Image source: CDC

Climate Change, Water Quality, and Human Exposure



https://data.globalchange.gov/report/usgcrp-climate-human-health-assessment-2016/chapter/water-related-illnesses/figure/links-between-climate-change-water-quantity-and-quality-and-human-exposure-to-water-related-illness

Reported Vibriosis Cases — Virginia, 1986-2018 (n=842)

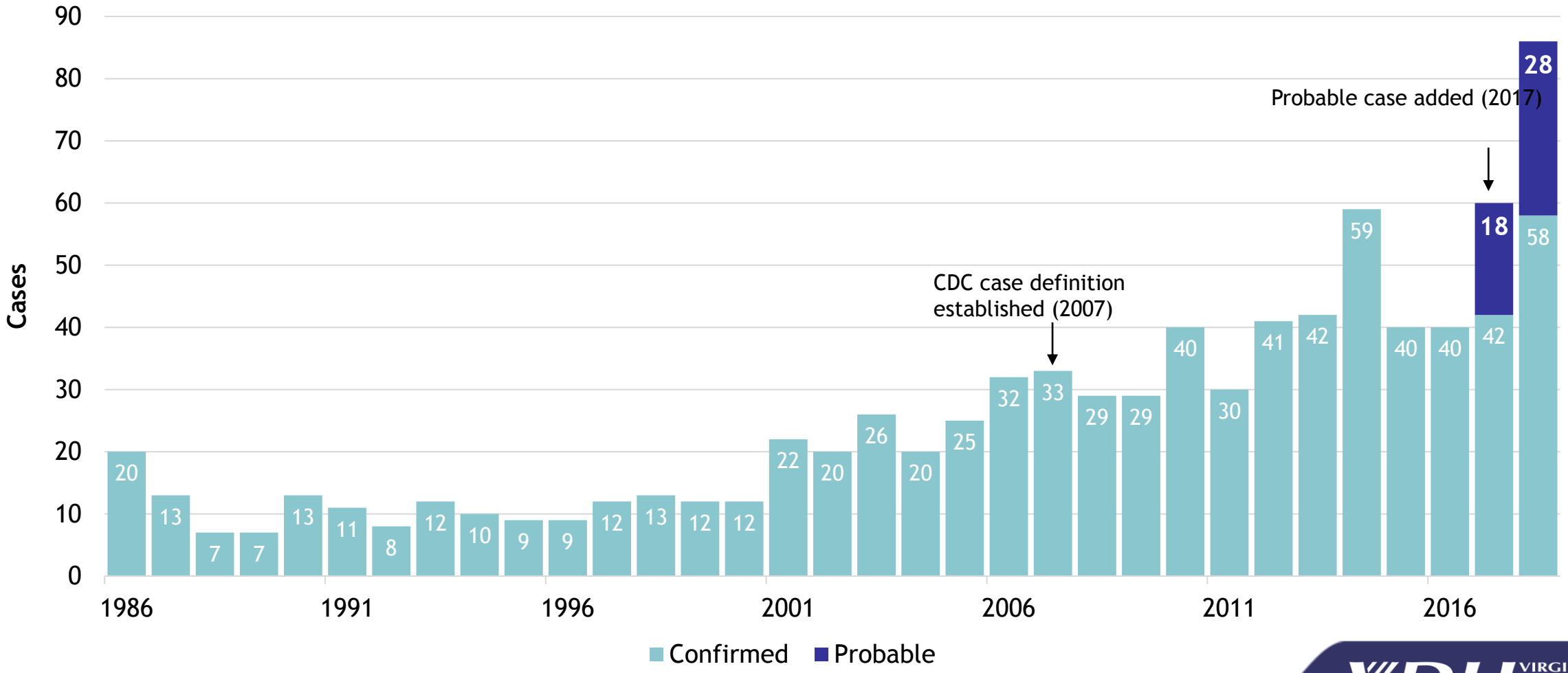
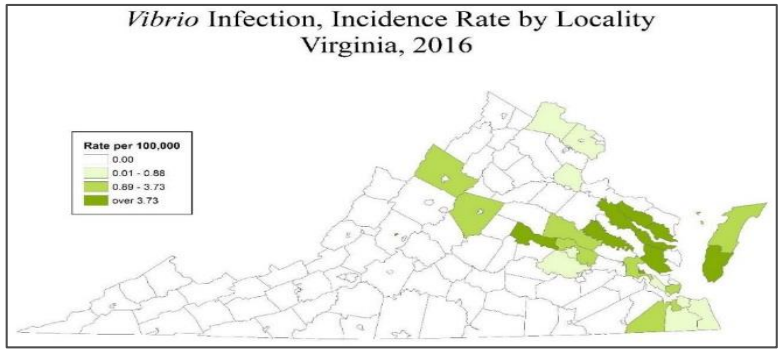


Image Source: http://www.vdh.virginia.gov/content/uploads/sites/13/2018/03/Vibrio_Infection2016.pdf

Vibriosis Epidemiology — Virginia, 2014–2018 (n=285)

- Annual average: 57.0 cases
  - 19.6 hospitalizations
  - 1.2 deaths
- 63.9% cases in males
- Median age: 53 years (range 1–94)
- 79.7% cases in white persons*
- 93.5% cases in non-Hispanic persons**
- 46.7% in eastern region residents



* Race information available for 217 (76.1%) cases.
** Ethnicity information available for 138 (48.4%) cases.

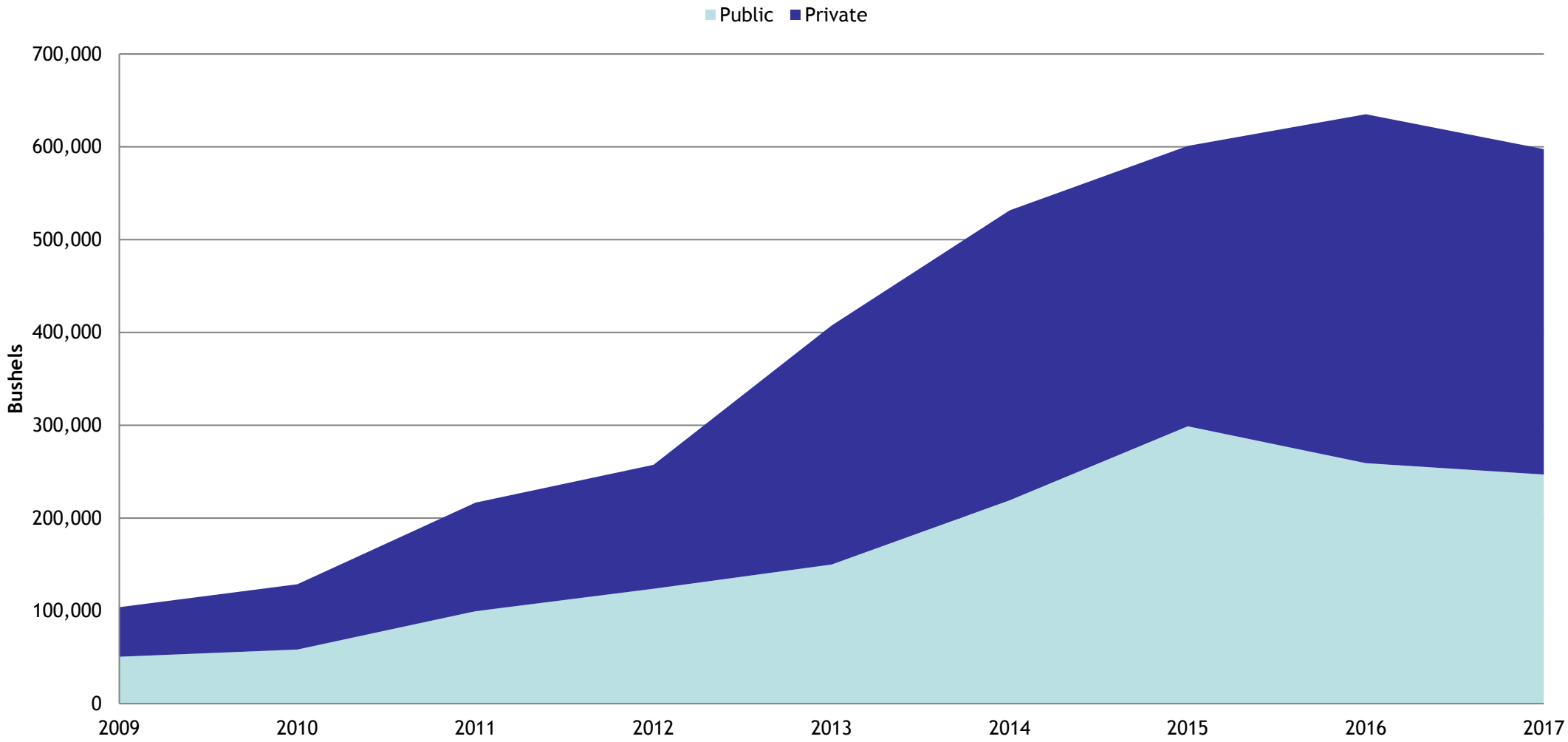
Health-Associated Costs of Vibriosis

- VDH has not conducted a state-level analysis, but national estimates provide insight into annual costs
- USDA's Economic Research Service estimates for foodborne illnesses
  - *V. vulnificus*: $319,850,293
  - *V. parahaemolyticus*: $40,682,312
- Ralston et al.'s estimates for illnesses from seafood consumption and beach recreation exposure
  - *V. vulnificus*: $261.33M
  - *V. parahaemolyticus*: $22.12M

Economic Research Service (ERS), U.S. Department of Agriculture (USDA). Cost Estimates of Foodborne Illnesses (2014). https://www.ers.usda.gov/data-products/cost-estimates-of-foodborne-illnesses/

Ralston EP, Kite-Powell H, Beet A. An estimate of the cost of acute health effects from food- and water-borne marine pathogens and toxins in the USA. J Water Health. 2011;9:680-94.

Virginia Oyster Production 2009-2017



Virginia Shellfish Industry & Regulatory Harvest Controls

Shellfish harvest controls are established based on a risk assessment that considers *Vibrio* case reporting and environmental conditions.

- VA harvesters currently have 3 options during warm weather:
  - Harvest curfews
  - On-board refrigeration / icing
  - Off-curfew time restrictions (GPS permit required)
- All harvest must be cooled to 55ºF within 5 hours
- Harvesters must provide shading over the storage area
- Clam deliveries requiring more than 60 minutes must be in temperature-controlled conveyances.

Summary

- Reported vibriosis cases in Virginia have been increasing since 2000
- Most cases occur in white, non-Hispanic males and many occur in eastern region residents
- Most foodborne vibriosis cases are associated with consumption of raw or undercooked oysters
- National healthcare-associated cost estimates are substantial, particularly for *V. vulnificus* infections

Questions?

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Katie Kurkjian
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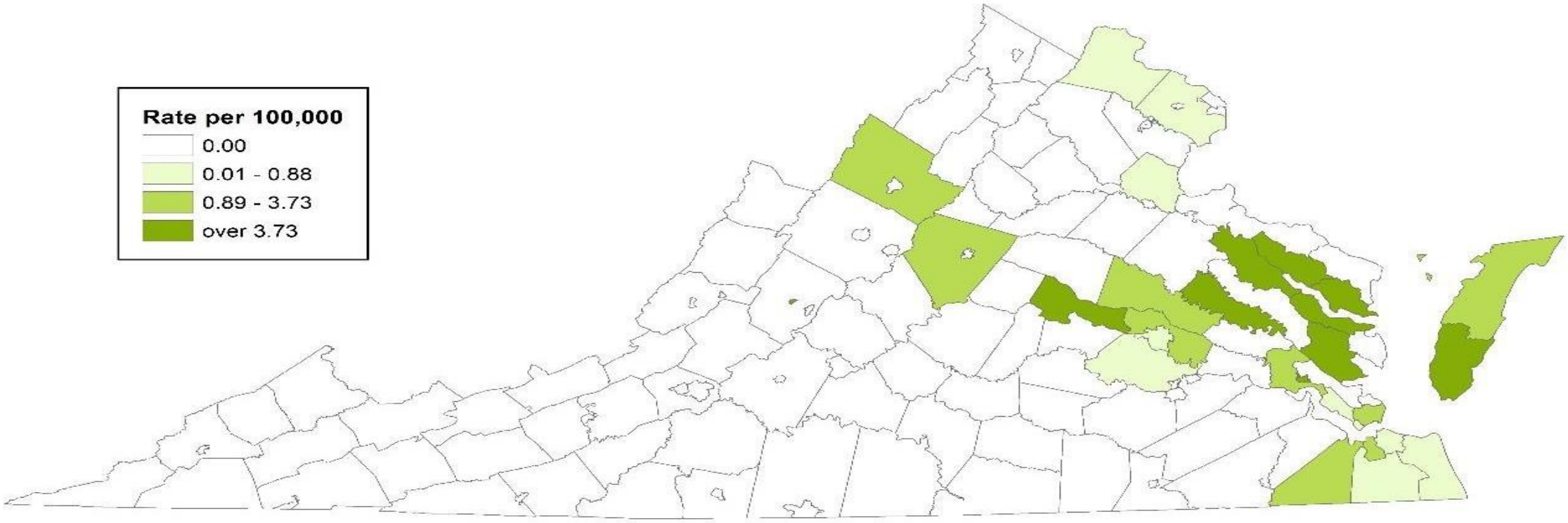
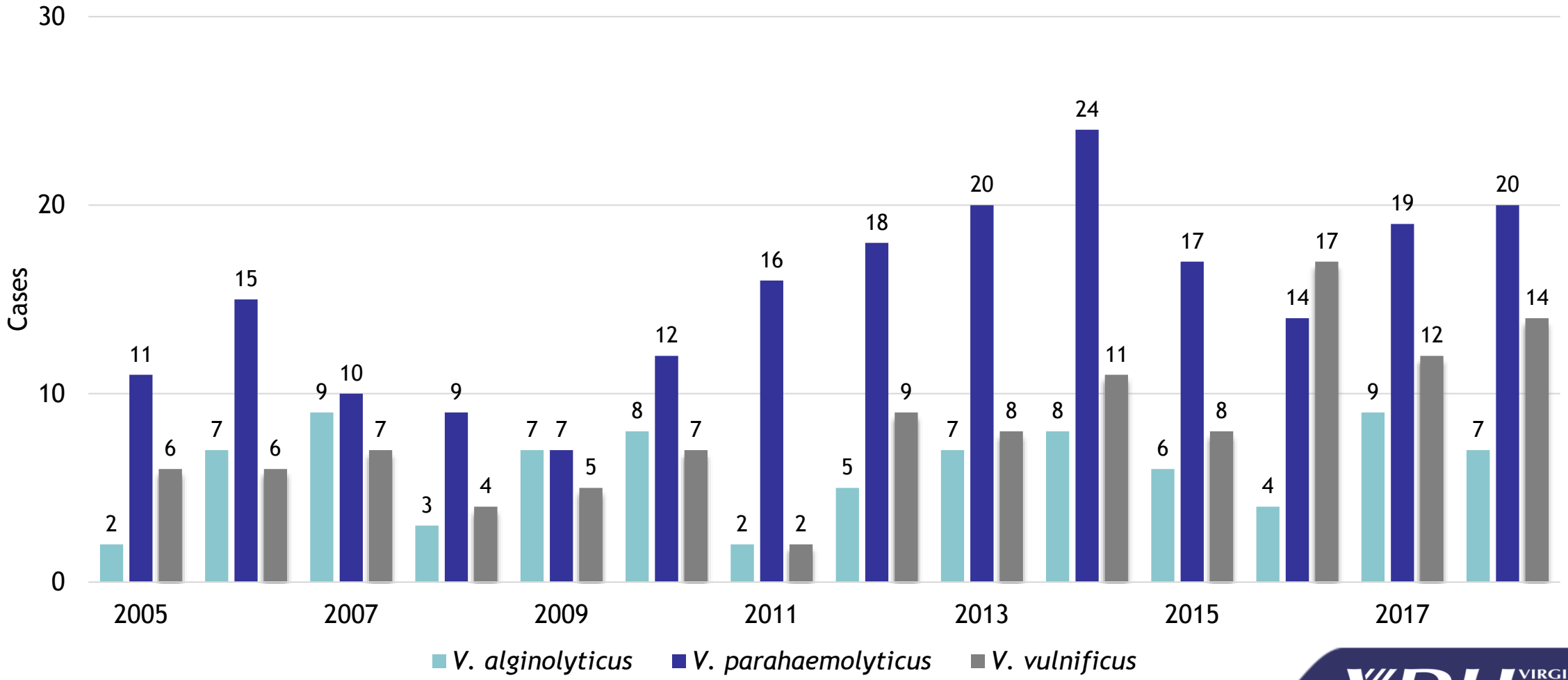
Katie.Kurkjian@vdh.virginia.gov

Vibriosis Incidence Rate by Locality —Virginia, 2016

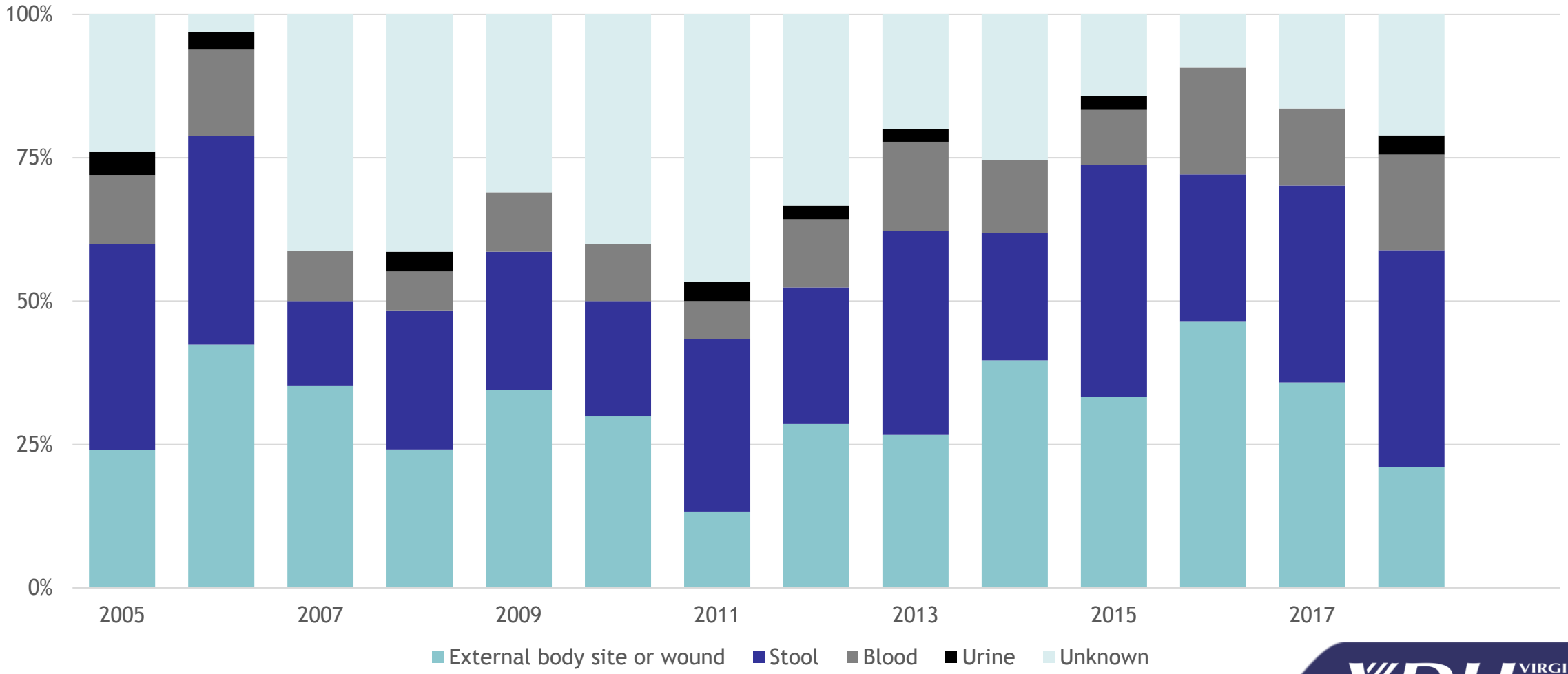


Source: Reportable Disease Surveillance in Virginia, 2016.

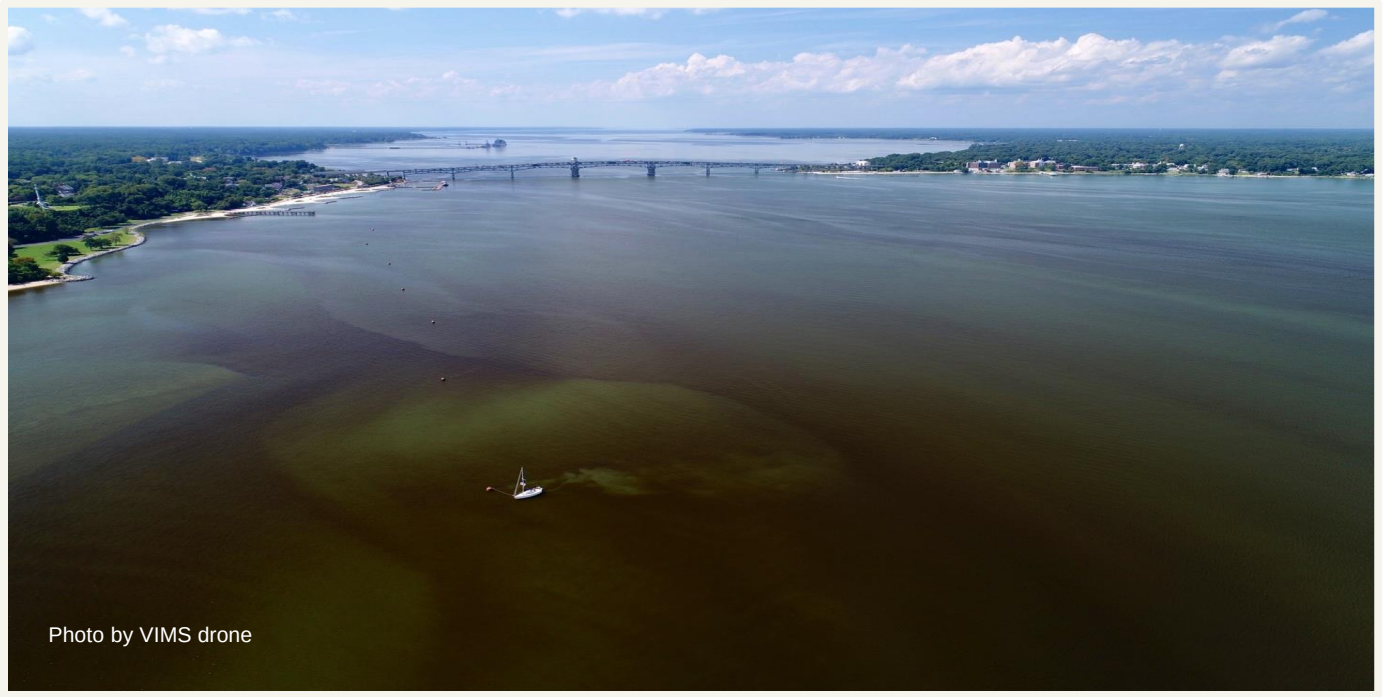
Top 3 *Vibrio* Species Identified by Culture — Virginia, 2005–2018 (n=412)

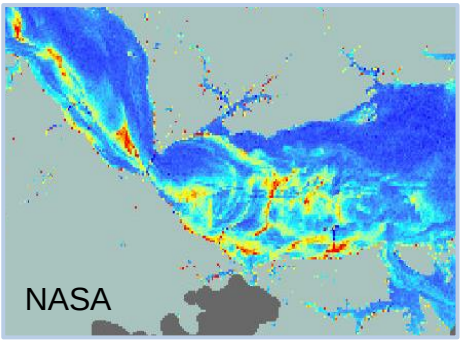


Specimen Sources for Vibriosis Cases — Virginia, 2005–2018 (n=612)

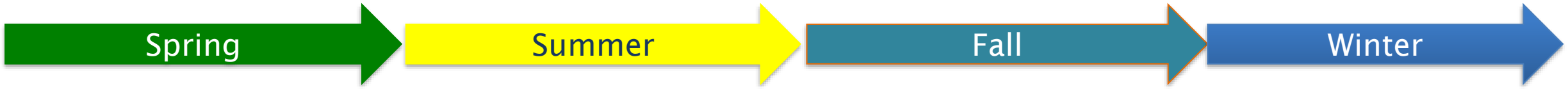


Changing Patterns of Lower Chesapeake Bay's Late Summer Blooms (changing climate?)





General 'Bloom' Pattern



Diatoms

Heterocapsa triquetra

Pseudo-nitzschia spp. (Toxin = Domoic acid) ✢

Dinophysis spp. (Toxin = Okadaic acid) ✢

Karlodinium veneficum (Toxin = Karlo toxin) ✲ *Prorocentrum* spp. ✲

Raphidophytes (Toxin = Brevetoxin?) ✢ ✲

Margalefidinium (Cochlodinium) polykrikoides ✲

Alexandrium monilatum- toxin = goniodomin ✲

✢ Possible human health effects: shellfish poisoning

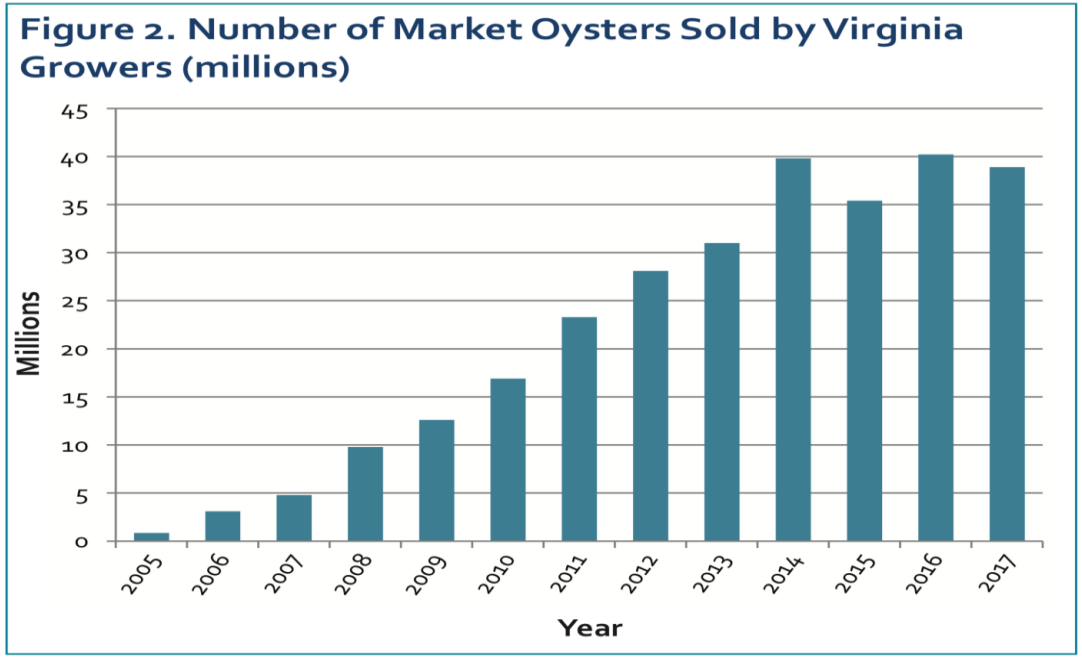
✲ Can be harmful to shellfish/fish

"Cochlo" or "Marg"
and
"Alex"

Shellfish Aquaculture: Rapidly growing industry in Virginia

Highlights:

- 2017 farm gate value for Virginia shellfish aquaculture was $53.4 million
  - $37.5 million Hard Clams
  - $15.9 million Oysters
- Virginia is 1st in the U.S. for hard clam production
- Virginia is 1st on the U.S. East Coast for oyster production
- Oysters are the most rapidly developing sector of Virginia's shellfish aquaculture
- Virginia's shellfish production relies on a system of vertically integrated private hatcheries

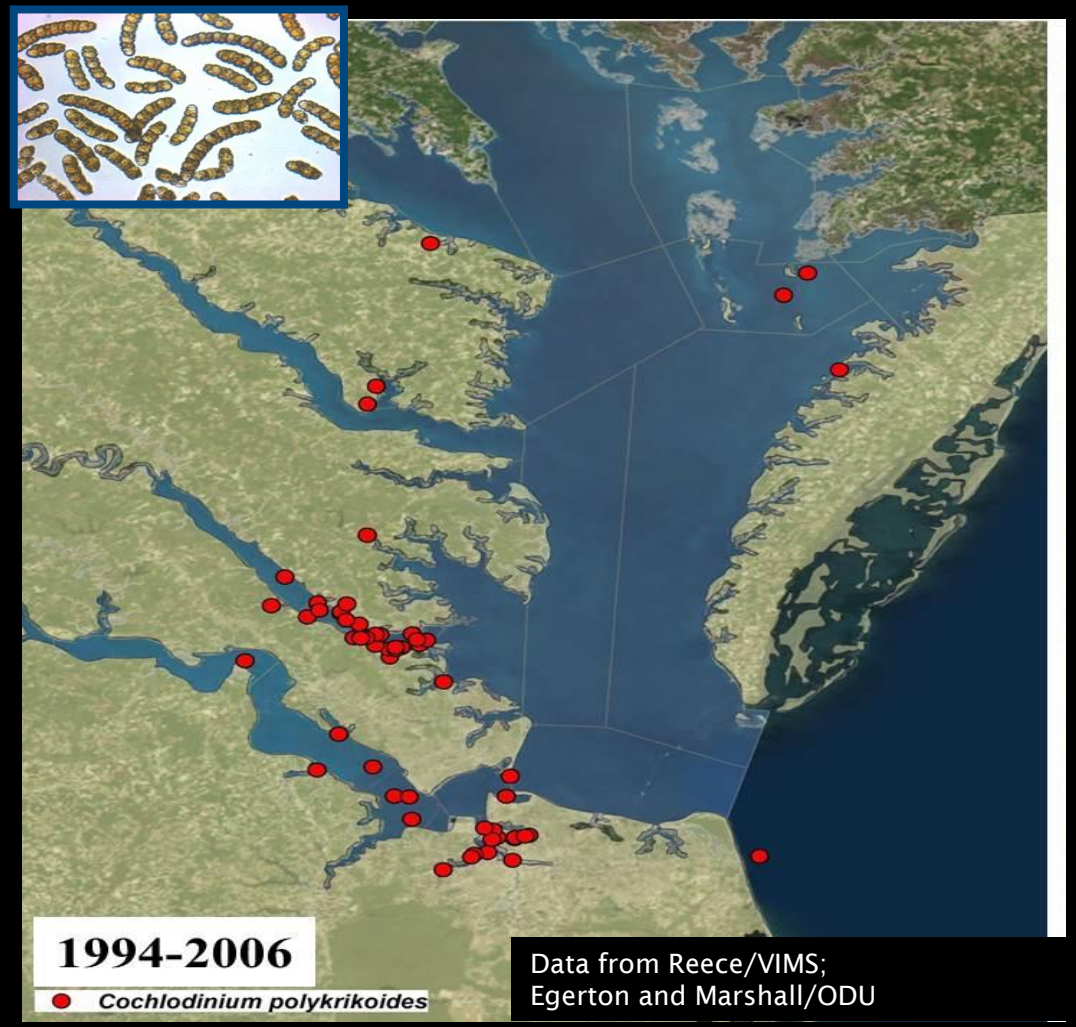


Are HABs a threat to industry growth?

- Hatchery production
- Nursery and adult grow-out

Hudson, 2018, VA Shellfish Aquaculture Situation and Outlook Report

Dominant Late Summer Bloom Species:1994-2006



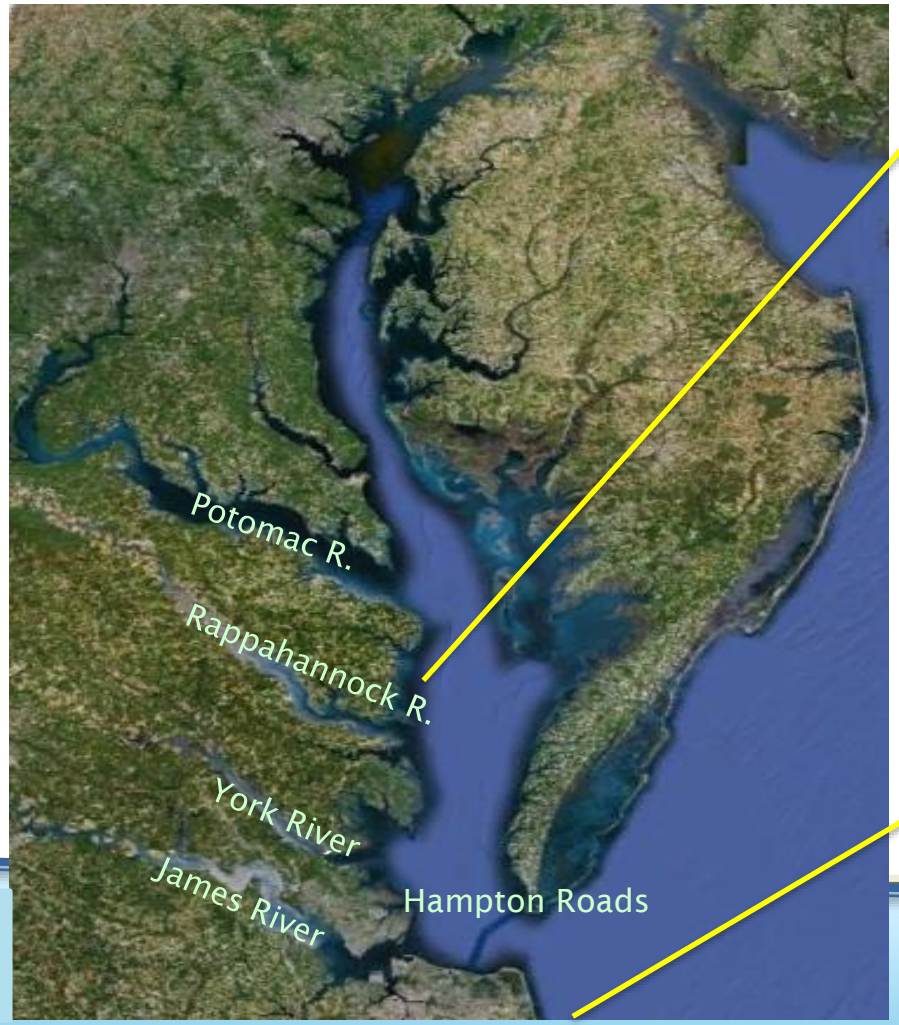
Marg/Cochlo

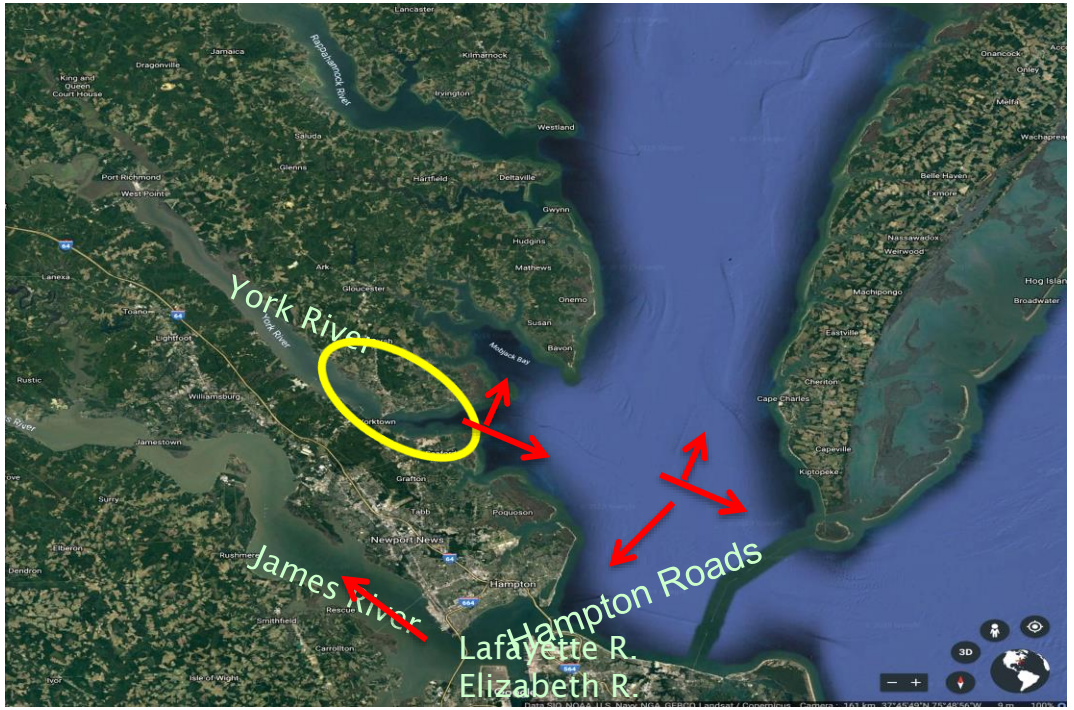
- *M. polykrikoides* bloomed throughout lower Chesapeake Bay having expanded its range from the York River region in the early-mid 1990's

Alexandrium monilatum

Expansion of *M. polykrikoides* and *A. monilatum* throughout lower Chesapeake Bay

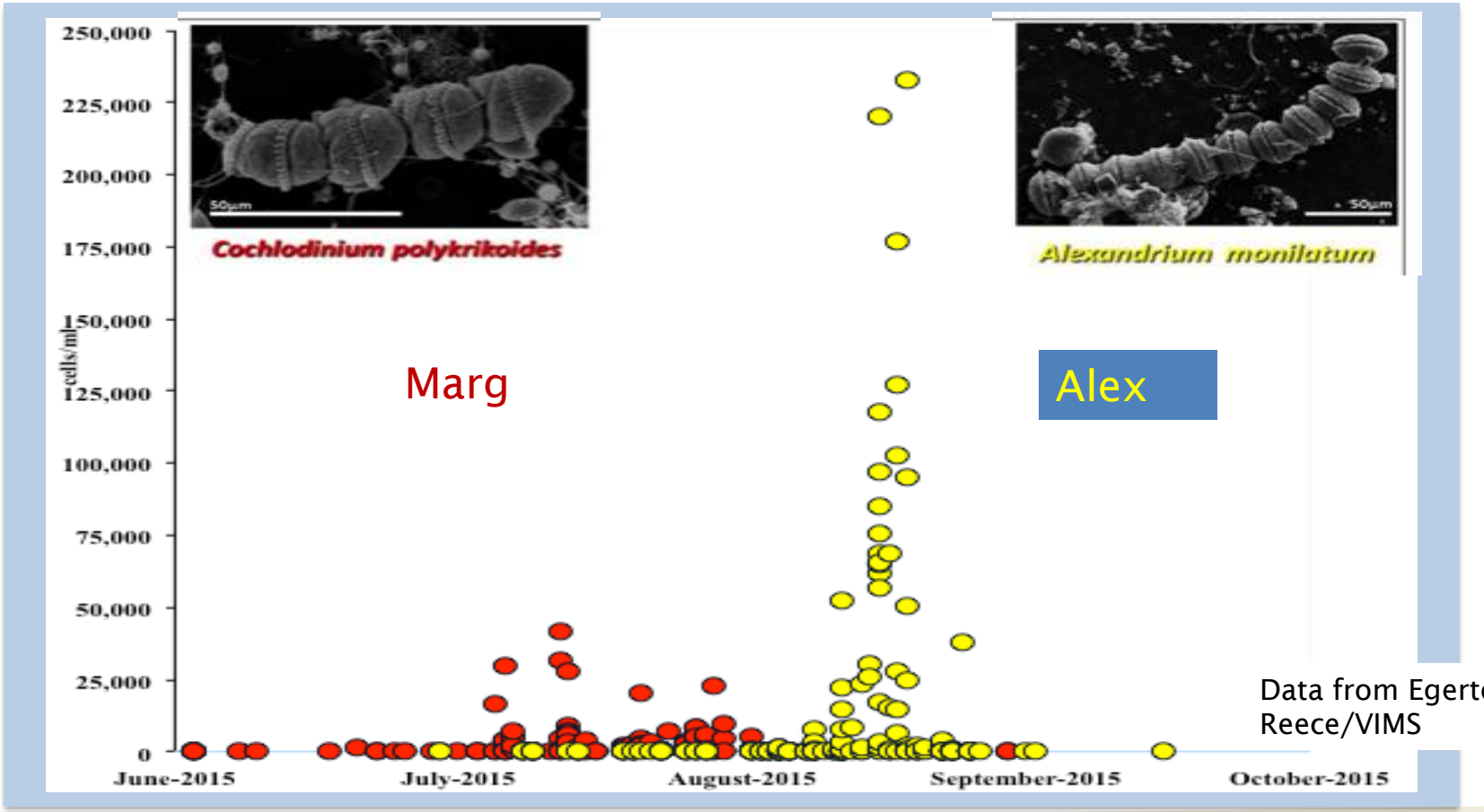
- Expansion north and south of the York River region. *M.p.*-40+ years, *A.m.* 10+ years
- *M.p.*: expanded in the 1990's (Marshall 1995, Marshall et al. 2005).
- *A.m.*: first recent bloom in the York River in 2007, expansion started 2012





Annual Bloom Progression

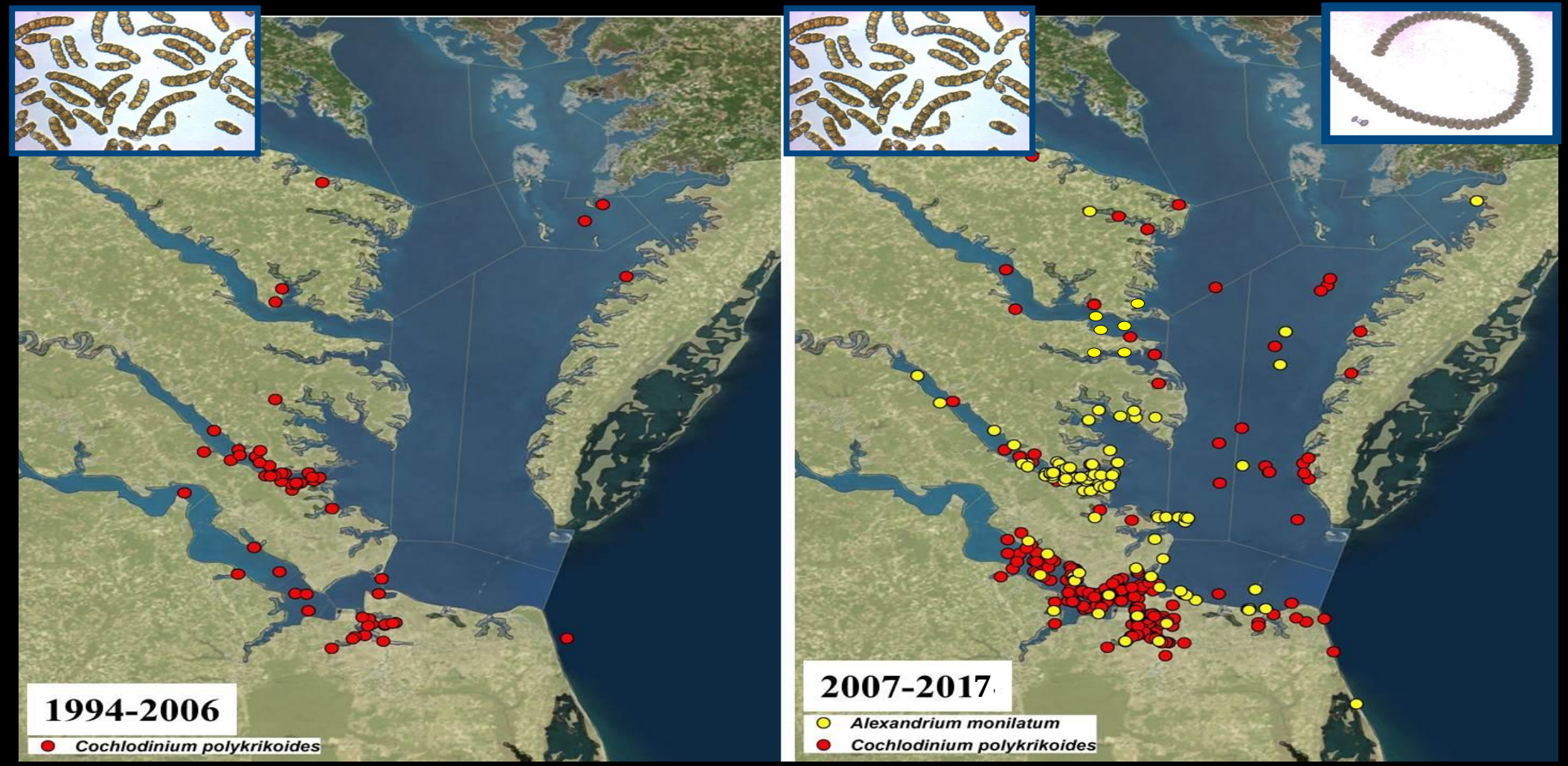
- Marg typically starts blooming in July through early-mid August
- Alex blooms August into September, even into October some years.



Data from Egerton ODU ; Reece/VIMS

Dominant Summer Bloom Species:1994-2017

Marg/Cochlo and Alex



- Alex blooms observed almost annually in York River region starting in 2007
- Highest densities in the York River with lower counts in a few samples outside the region through 2012 (large expansion of Alex in 2015 & 16)

Late Summer Bloom Impacts

- 2007 Alex bloom: ~500 VIMS *Rapana* whelks died in tanks with York River flow-through water (Harding et al. 2009)

- 2008 Alex bloom: The VIMS experimental cownose rays died in sand filtered tank with York River water being fed oysters from the York River

<u>Aquaculture Industry- Numerous years oyster mortality reported</u> in York River region during blooms

- 2015: York River Region- oyster growers reported extremely high mortality (>60-70% - fall/winter harvest animals)
  - Heavy bloom of long duration
  - Higher mortality with inter-tidal vs. sub-tidal oysters at lower energy/low flow

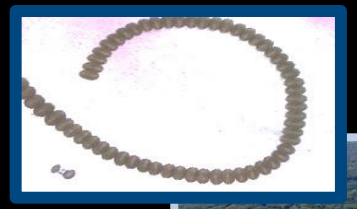
Marg – July – early Aug.

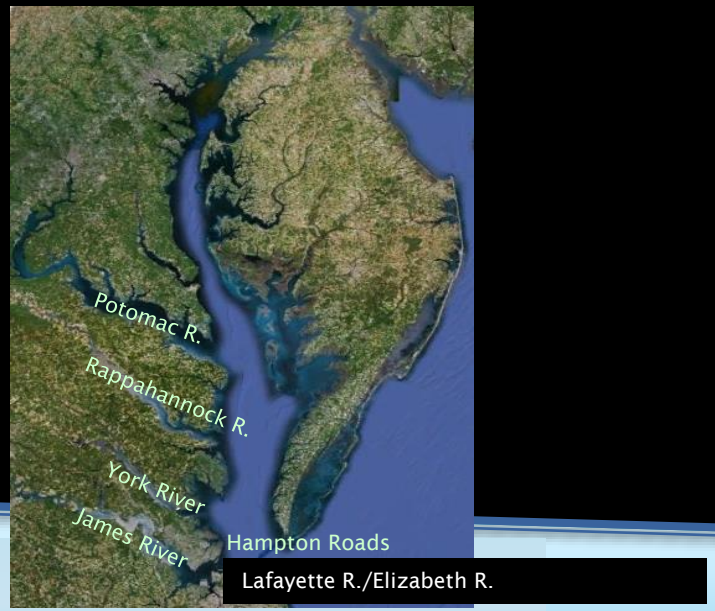
York River

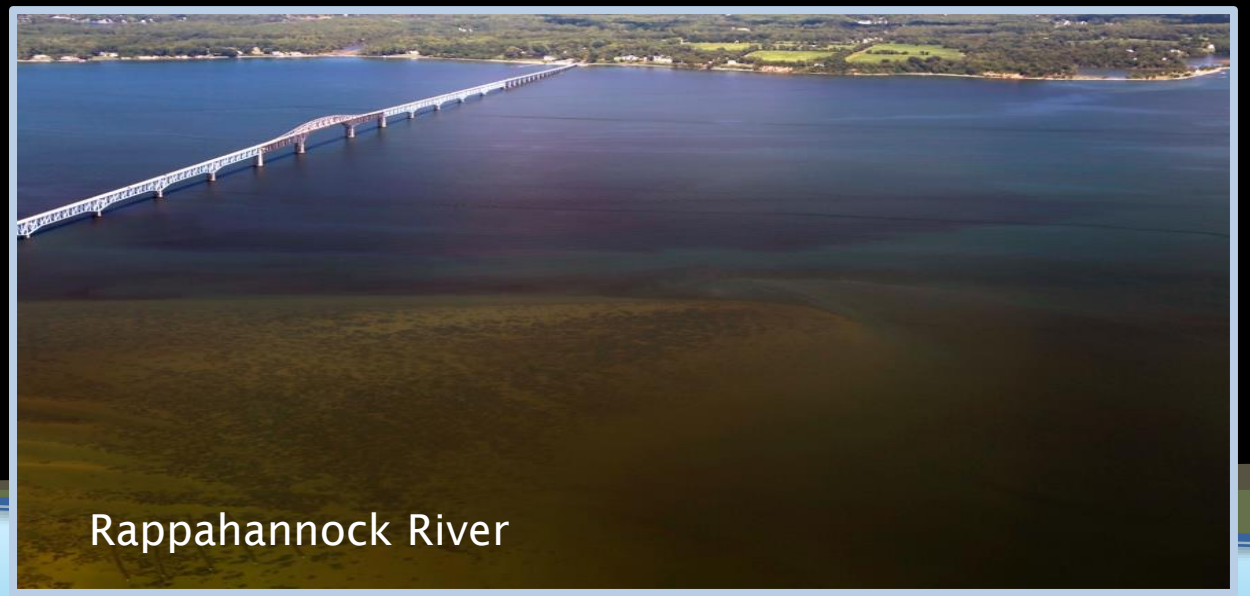
Elizabeth River

Photos by W. Vogelbein

Alex- Late Aug. - Sept.

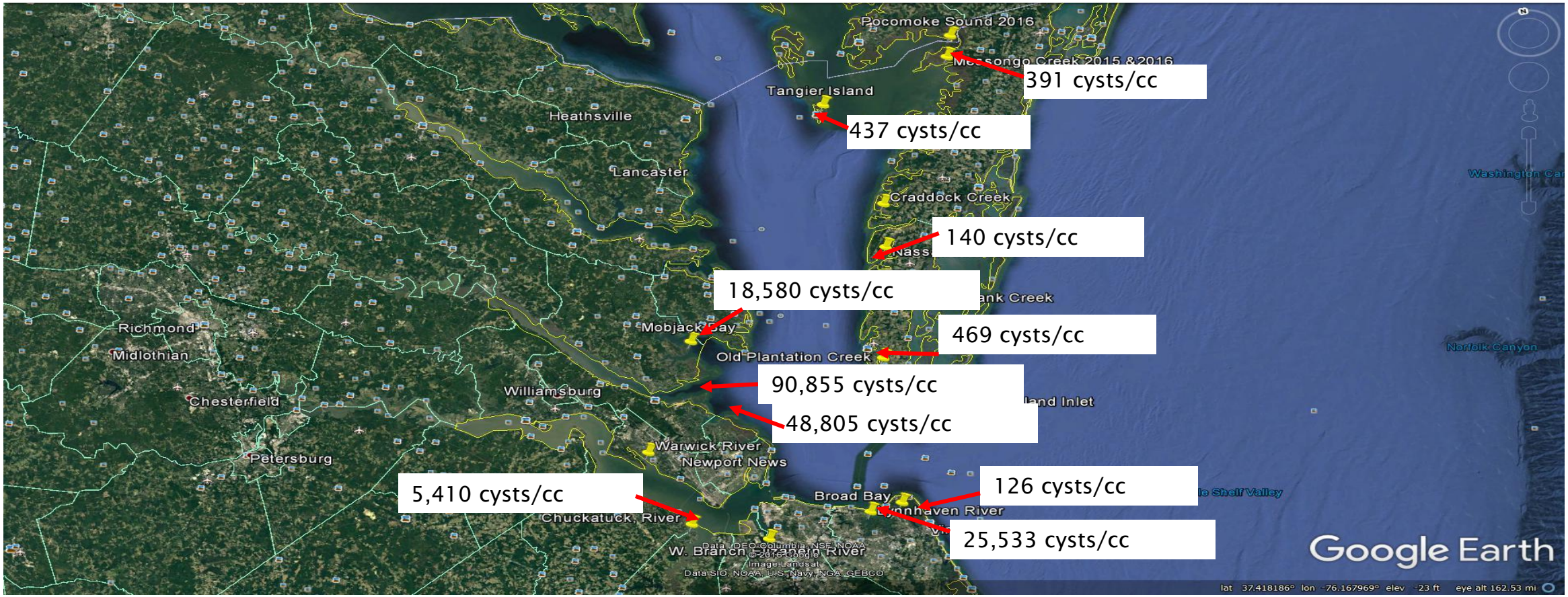




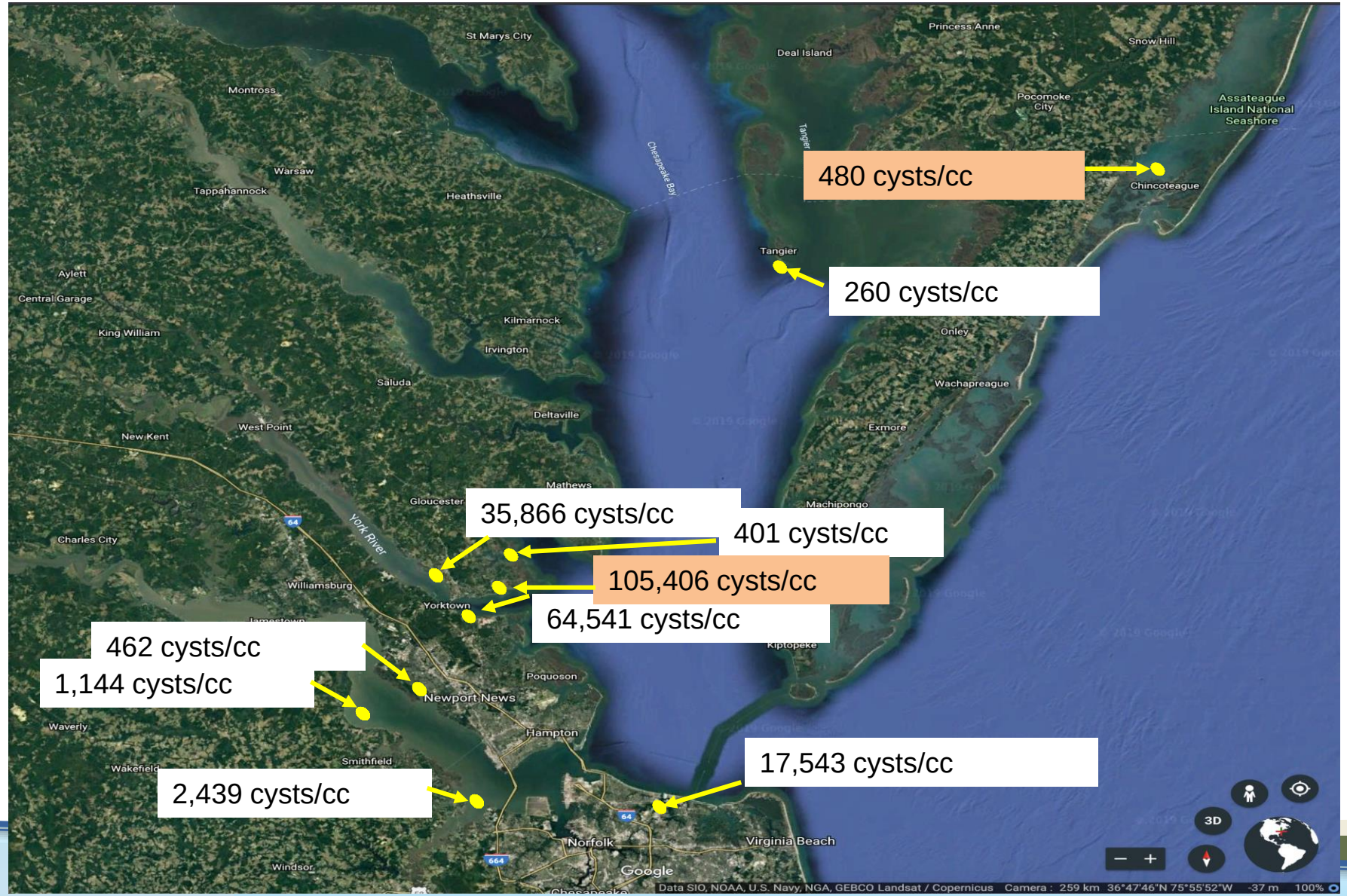


A. monilatum Cyst Bed Now Established Throughout Southern CB

qPCR Analysis of Sediment Samples - 2016



A. monilatum Cyst Bed -2017



Bioluminescence by *A. monilatum* has been reported throughout the region

Photo by W. Vogelbein

Thank You

Photos by S. Maples

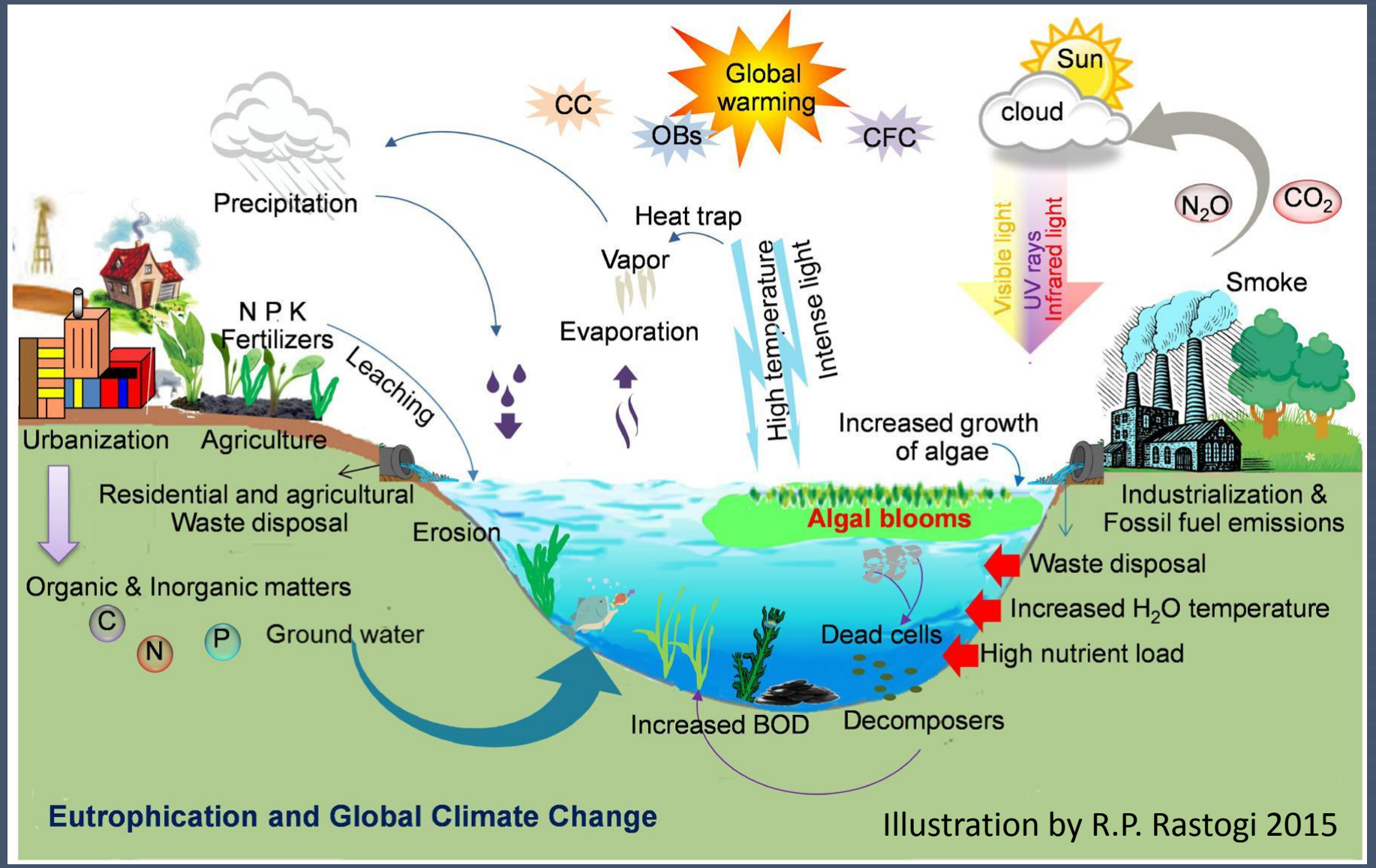
Harmful Algae Blooms (HABs): *Highlights of Global & National Impacts*

Margaret Smigo, MS
Virginia Department of Health
Waterborne Hazards Program Coordinator

What is a "HAB"?

- Algal blooms are natural & occur in freshwater & marine habitats
- Environmental conditions which favor the growth of one or more algae
- "HABs" produce compounds that result in human/animal illness or otherwise cause mortality
- Uncommon; typically summer/fall
- ~73,000 species of algae:
  <100 known species produce toxins

What factors contribute to HABs?



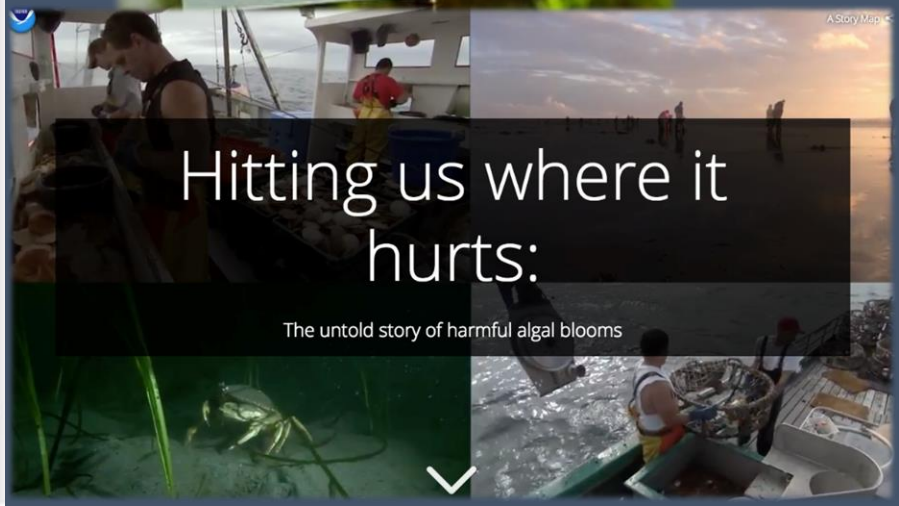
What are the Impacts of HABs?

- Economic
  - Recreational closures
  - Shellfish closures
  - Drinking water closures
  - Socio-economic hardship
- Public Health
  - Acute exposure
  - Chronic exposure
- Ecosystem
  - Bioaccumulation & toxin transfer within food-web
  - Aquatic health stressors
  - Anoxic/hypoxic zones

CONSERVATIVE ANNUAL COST:

- **Marine HABs**
  - USA ± US$ 95 million
  - Europe > US$ 850 million
  - Asia > US$ 1 billion
- **Freshwater HABs**
  - USA ± US$ 4,6 billion
  - China ± US$ 6,5 billion (1998, Lake Tai)
  - Australia ± US$ 150 million
  - UK ± US$ 150 million
  - South Africa ± US$ 250 million

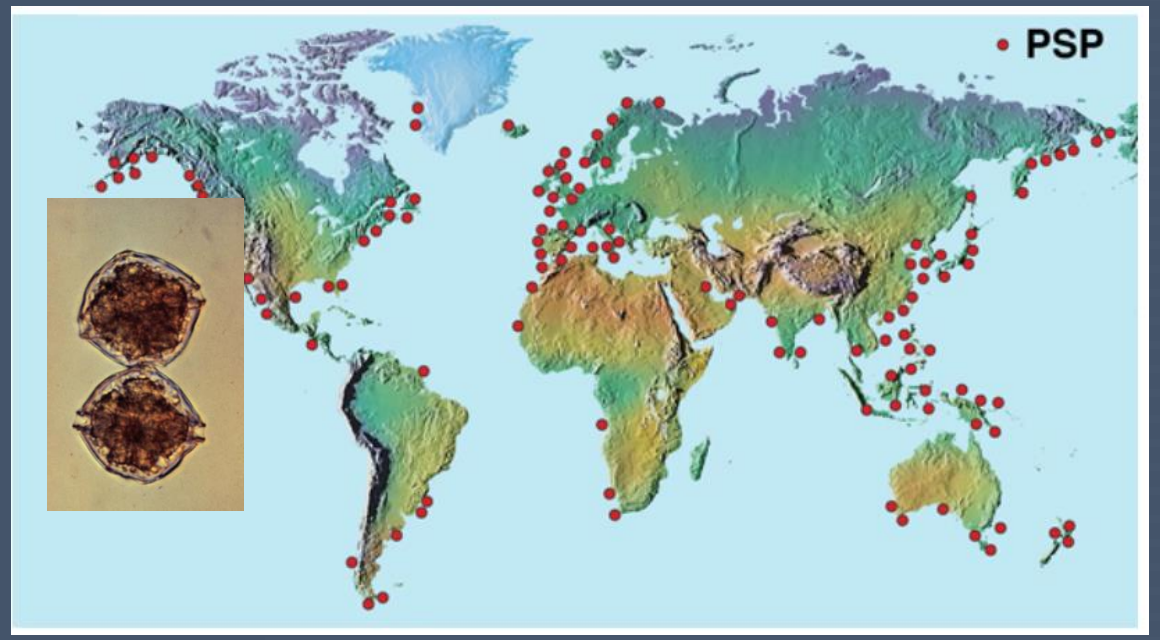
Source: Bernard et al., 2014, Developing global capabilities for the observation and prediction of harmful algal blooms. Oceans and Society: Blue Planet. Cambridge Scholars Publishing. PICES Scentific Report, No. 47, 2014. http://pices.int/publications/scientific_reports/

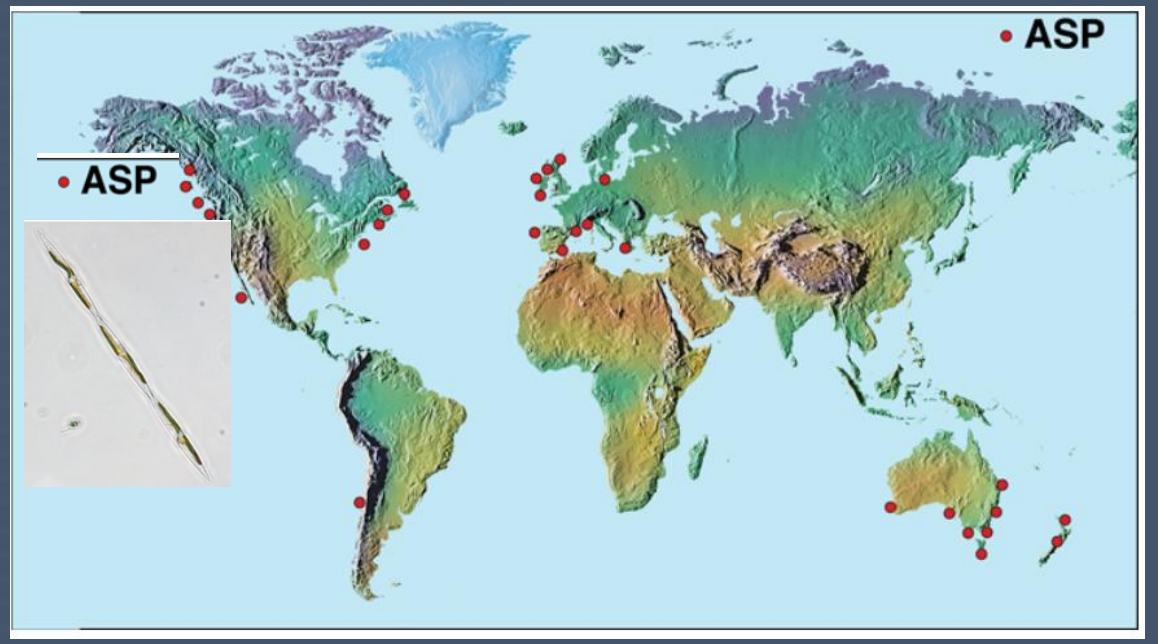


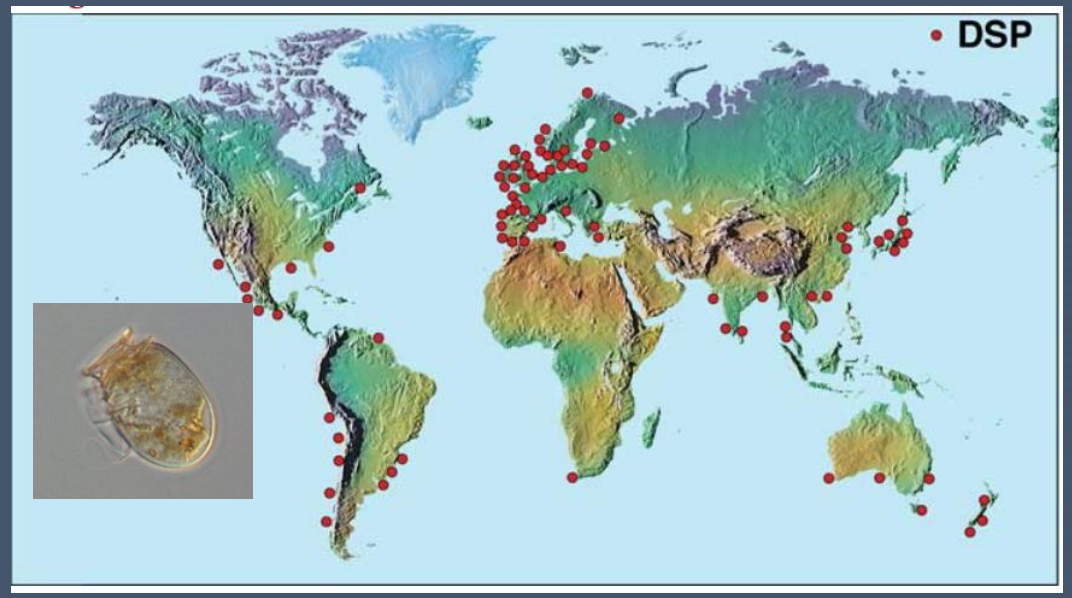
https://www.nwfsc.noaa.gov/research/divisions/efs/microbes/harmful_algae/storymap.cfm

http://www.beachapedia.org/File:HABs_EconomicImpactsofHABs.png

Global distribution of Marine HABs



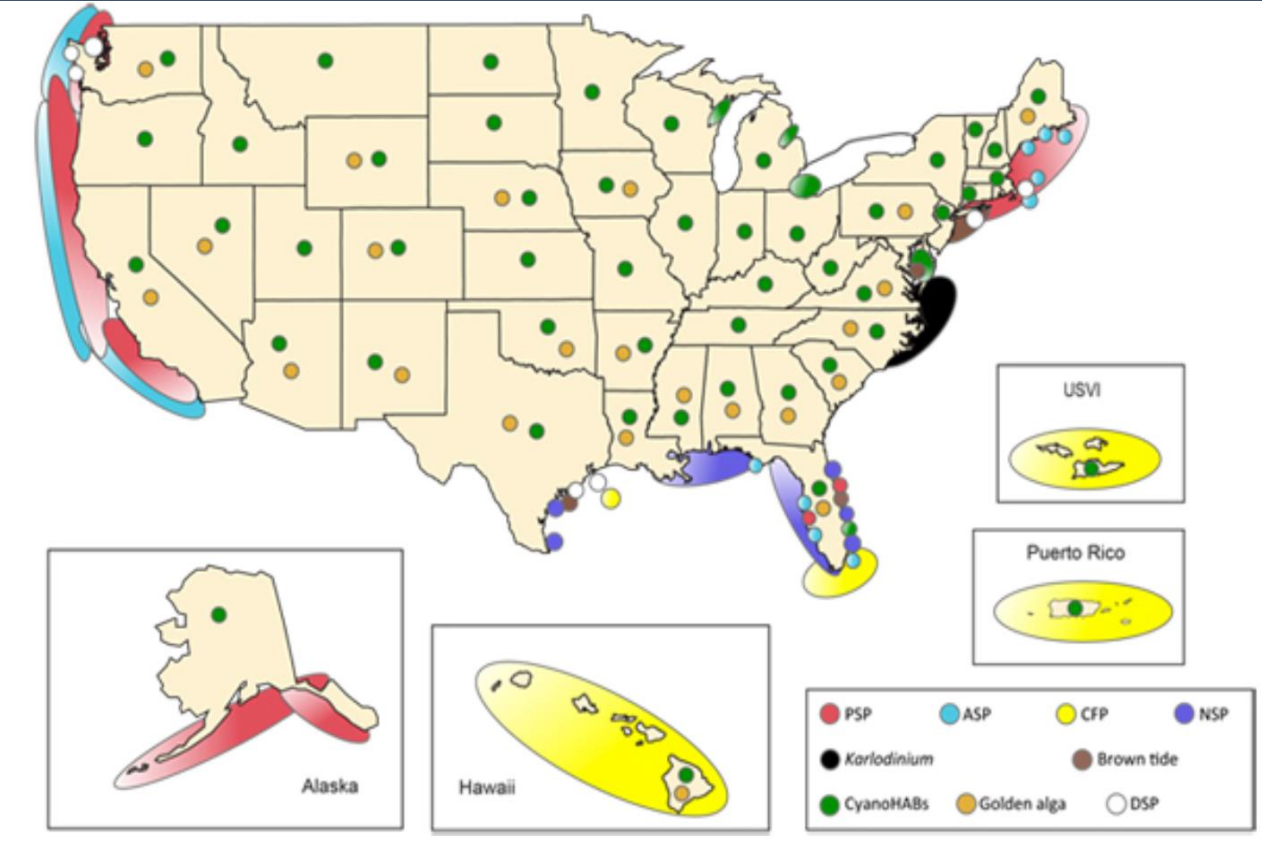




Woods Hole Oceanographic Institution

www.whoi.edu/redtide

HABs Across the United States



https://www.whoi.edu/redtide/regions/us-distribution

Toxic algae bloom shuts down West Coast fisheries

Sea lions poisoned with domoic acid sit in recovery pens at the Marine Mammal Care Center in San Pedro in 2007. A recent, huge bloom of algae off the West Coast has killed sea birds and sickened marine mammals from Central to Northern California, experts found. (Rick Loomis / Los Angeles Times)

By JOSEPH SERNA
contact the reporter

Tap Water Ban for Toledo Residents

By EMMA G. FITZSIMMONS AUG. 3, 2014

The discovery of high toxin levels in water from Lake Erie had residents in Toledo, Ohio, relying on bottled water while local supplies were being tested. Joshua Lott/Reuters

National Ocean Service OCEAN FACTS EXPLORE EDUCATION NEWS MULTIMEDIA

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West Coast Harmful Algal Bloom

NOAA **responds to unprecedented bloom** that stretches from central California to the Alaska Penir

...g the Washington state coast. So far this year, the presence of harmful algal bloom toxin in ...e water's has resulted in fishery closures, which can have tremendous economic and ecological ...he razor clam fishery closed resulting in an estimated $9.2 million in lost income. The state's fishery, worth roughly $84 million annually, has also been affected.

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LOCAL

Lake Erie, S. Florida algae crises share common toxins and causes

By Tom Henry | BLADE STAFF WRITER

Published on July 24, 2016 | Updated 10:04 a.m.

...ter thick with algae laps the shore of the St. Lucie Estuary. Phosphorus-rich water released ...n Lake Okeechobee feeds blooms in the estuary.

PALM BEACH (FL